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The WELDING Journal

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The Journal of the American Welding Society

FROSTRODES are Engineered

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Heart of the "Frostrode" Unit. This 20 ft. coil does the work of 200 ft. of 5/8 in. tubing. Large demand for "Frostrode" units justified the special tooling required to make these coils.

"FROSTRODE" electrode refrigerating units are more than 'brine coolers'.* They are specially designed and built for welding installations by an organization thoroughly familiar with welding problems and welding practice.

They are not built to a price. Since their cost is only a small part of the total welder installation, smart engineering calls for the best possible parts and workmanship to prevent a failure which would tie up the entire installation.

With "FROSTRODE" units you can change electrodes without fussing with valves—the coolant automatically syphons from the electrodes and drains back into the tank when the pump shuts off. This is an exclusive "FROSTRODE" Feature.

"FROSTRODE" units are compact. Individual units have a work-table top increasing their usefulness in welding installations.

Among dozens of manufacturers already using "FROSTRODE" units in quantities** are such organizations as:

Eastern Aircraft Corporation
Ford Motor Company
Glenn L. Martin Company
Goodyear Aircraft Corporation
Inter-Continent Aircraft
John Deere Harvester Company
Murray Corporation
North American Aviation
Republic Aircraft Corporation
Willys-Overland Motors, Inc.

** "COOLANT". "FROSTRODE" units are now coming off the line filled with a new non-corrosive high specific heat coolant.*

*** At the time this was written, some 133 "FROSTRODE" units were already in daily operation to improve spot-welds, increase life between tip-dressing and reduce welding costs.*

STANDARD FROSTRODE MODELS

Model	Style	*No. Atom. Wldrs.	*Size & No. Steel Wldrs.	Coolant Temp.	Coolant Pumps	Phase Elect Line
251-A	Crane mtg. for gun wldr.	1	1 Very Light	20°	1	1
R501-A1	Roll out for inside wldr.	1	.....	0°	1	1
R501-A3	Roll out for inside wldr.	1	.....	0°	1	3
R501-C41	Cabinet	1	.....	40°	1	1
R501-C43	Cabinet	1	.....	40°	1	3
R751-C1	Cabinet	1	1 Light	0°	1	1
R751-C3	Cabinet	1	1 Light	0°	1	3
R1002-C43	Cabinet	2	.....	40°	2	3
R1501-A	Cabinet	2	1 Medium	0°	1	3
R1502-A	Cabinet	2	2 Light	0°	2	3
R3001-A	Cabinet	.	1 Heavy	20°	1	3
R3002-A	Cabinet	4	2 Medium	0°	2	3
R3003-A	Cabinet	3	.....	0°	3	3
R3004-A	Cabinet	4	4 Light	0°	4	3
R5001-S	Cabinet	.	1 Extra Heavy	0°	1	3
R10002-S	Cabinet	.	2 Extra Heavy	0°	2	3

One of the individual type "FROSTRODE" refrigerating units with work table top.

One of the "FROSTRODE" units designed to take care of two welding machines.

FROSTRODE DIVISION

WELTRONIC CORPORATION

3080 E. Outer Drive, Detroit

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The American Welding Society
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The Conservation of Steelmaking Raw Materials*

By Charles M. Parker†

IN the days before our nation was faced with war, the procurement of materials for the manufacture of steel products depended only upon a desire to possess them and the ability to pay for them. The merchant fleets of all maritime nations sailed the seas without fear, loading and unloading their cargoes in all ports of the world. Generally speaking, supply was equal to or greater than demand, trading was largely unrestricted and transportation facilities were readily available. In those times, the steel industry in the United States was drawing on distant lands for the materials necessary to satisfy the needs of steel consumers. Its list of sources of essential raw materials recalls to mind the glamour and romance of the clipper ships of nearly a century ago: aluminum from Surinam; calcium-silicide from Norway and France; chromium from Southern Rhodesia, Turkey and the Philippines; cobalt from the Belgian Congo and Finland; columbium from Nigeria; manganese from Russia, the Gold Coast and British India; nickel from Canada; palm oil from the Belgian Congo; tin from British Malaya and the Dutch East Indies; titanium from Australia and Brazil; vanadium from Peru and Southwest Africa; tungsten from China and British Malaya; and zirconium from Australia, India and Brazil.

With the advent of war in far-off lands, some of our sources of supply were shut off completely; others were made more difficult of access either because of conflict or because of restrictions imposed by the belligerent nations; and others became areas of limited availability because of the fierce competition for their products that existed among neutrals and belligerents alike.

The first restriction which affected technical practices in the manufacture of steel was that which regulated the distribution of aluminum. As you know, aluminum is used in steelmaking as a deoxidizing agent and as an alloying element. Aluminum used as a deoxidizing agent confers upon steel more definite response to heat treatment, improved physical properties and the required degree of surface perfection demanded for highly finished

* Presented before New York Section, A.W.S., October 6, 1942.
† Secretary, General Technical Committee, American Iron and Steel Institute.

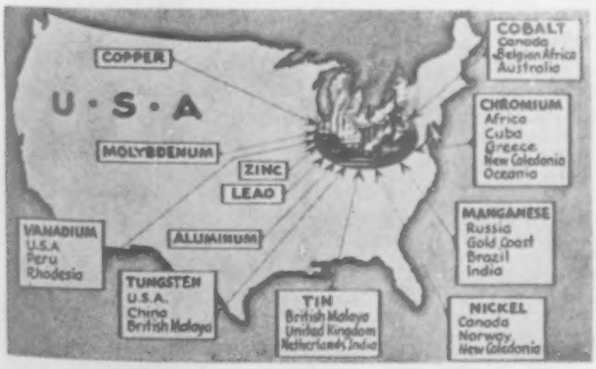


Fig. 1—Sources of Non-Ferrous Metals Used in Steelmaking

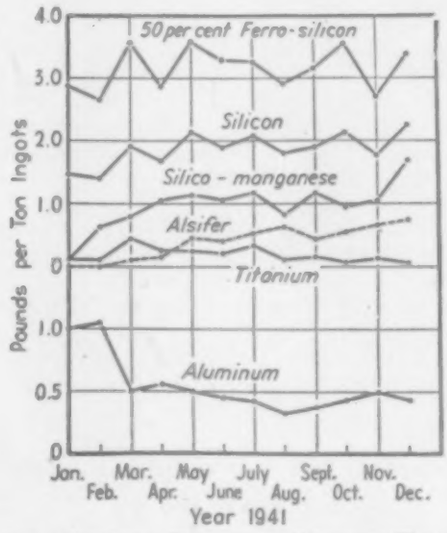


Fig. 2—Aluminum Conservation Measures (Herty*)

* Herty, C. H., Jr., "Conservation of Aluminum and Manganese," *A.S.T.M. Bulletin No. 117*, August 1942.

Table 1—Strategic Elements

Metal	Per Cent of World Production Produced in U. S. in Recent Years	Consumed in U. S. in Recent Years
Aluminum	30	40
Chromium	Insignificant	40
Cobalt	None	10
Manganese	Insignificant	20
Molybdenum	80	30
Nickel	Insignificant	50
Tungsten	10	20
Vanadium	15	25

products. It increases the yield of finished products from ingots by minimizing the effects of segregation and surface defects. In the production of such items as tool steel, stainless steel, heat-resistant steels, constructional alloy steel, plates for welding, forgings and carbon steel bars which are to be heat treated, aluminum is essential to maintain high quality.

In 1940, the steel industry used an average of 0.70 lb. of aluminum per ton of ingots. By June of 1941 consumption had dropped to 0.56 lb. per ton of ingots and has held constant at that figure to the present time. That reduction, which amounted to conserving at the rate of approximately 11,000,000 lb. per year, was accomplished largely by the use of substitutes.

Figure 2 shows the various steps taken by a representative plant to decrease aluminum consumption. Those steps involved increased consumption of 50% ferrosilicon, silico-manganese, alsifer and titanium, and a very careful check on all practices involving the addition of aluminum in order that consumption should be kept to a minimum, consistent with steel quality.

The interchangeability of aluminum with other deoxidizers in certain grades of steel makes it possible to balance deoxidation practices depending on the current supply of the various alloys involved and the statistical position of aluminum at any given time. Moreover, extended observation and empirical research revealed that less pure grades of aluminum than had hitherto been used could be employed successfully, provided adequate care was taken. With those moves the steel industry was launched on a program of conservation and substitution which has up to now, by no means run its full course.

Manganese is the most important non-ferrous element, used in the production of steel. It is a versatile element acting as a deoxidizer and conferring upon steel its ability to be rolled and forged successfully and with a

Fig. 3—Sources of Manganese

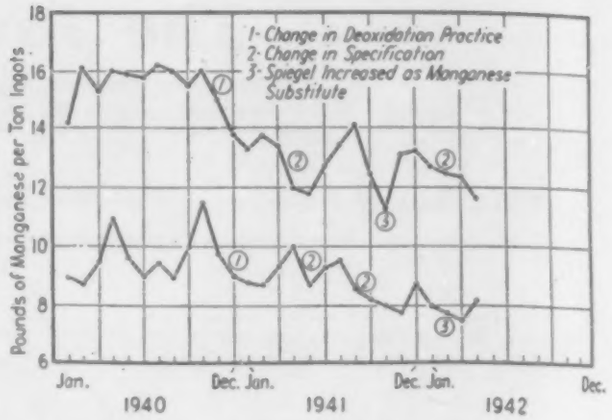


Fig. 4—Manganese Conservation Measures (Herty)

good surface finish. It also acts as an alloying element and is used partially to replace decreased quantities of nickel and chromium in constructional alloy steels.

The position of manganese supply is temporarily "easy" but it is such an important element in the manufacture of steel that our supply must be carefully guarded. Definite plans have been laid to supplement or partially supplant foreign supply by domestic sources.

The responsibility for manganese conservation is the common problem of producers and consumers. The use of a given amount of manganese in the manufacture of any steel product is governed primarily by specifications set by steel producers. Such specifications are designed to contribute to the physical properties of the finished steel or to enhance the surface quality obtained in rolling, forging or casting. Equally important are the standard specifications set up by steel consumers, in which the manganese ranges specified are designed to contribute to certain definite physical property requirements or to heat-treatment processes.

Among the problems to be solved by steel producers is the determination of the limits to which reduction of the manganese content of steel can be carried without impairing surface quality, production rates or both. In dealing with these problems as related to carbon steels there are two possible methods of attack, the first of which is to change from a fine grain to a coarse grain steel.

Such a change would permit a reduction in manganese content, with little or no change in the carbon content, but it would affect surface quality and segregation. There would probably be more surface preparation required for rolling in the steel mill, and somewhat higher rejections due to surface defects. Production might be slowed down on blooming mills and double heating might be necessary; moreover, somewhat higher rejections might be expected because of segregation in top billets.

In forging the steel there might be increased rejections because of cracking in the trimming operations. On the part of the consumer it might be necessary to revise heat-treatment cycles, and there would probably be slight changes in physical properties, principally in poorer ductility, but somewhat better machinability.

The second approach to the problem is to lower the manganese content and increase the carbon content without interfering with the grain size characteristics. This change would involve the possibility of a change in the heat-treating cycle and some lowering of impact properties. In addition, in the higher carbon ranges, there would probably be some decrease in machinability.

The consumption of manganese in the steel industry

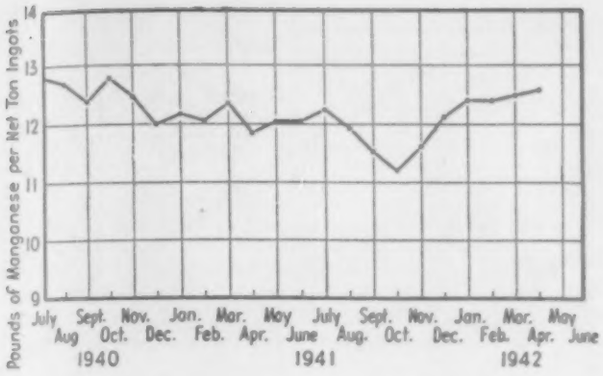


Fig. 5—Manganese Consumption (Herty)

is currently about 12.5 lb. per net ton of ingots. This represents a slight increase over consumption in 1940 and is a result of the decreased tonnages of low manganese steels, under 0.40% manganese, the increased tonnages of steels in the range of 0.50 to 1.00% manganese, and the increased production of the higher manganese grades, balanced against the efforts which have been made to date on manganese conservation. It can be stated that, roughly, a decrease of one pound of manganese per ton of ingots is equivalent to lengthening our manganese reserves by one month or that such a decrease will permit a higher tonnage of high manganese steels to be produced without a greater rate of over-all manganese consumption.

Figure 4 shows the results of conservation efforts in two different open-hearth plants where the grades of steel produced have not changed materially in the past two years. In one of those plants, manganese consumption has been decreased from about 16 lb. per net ton of ingots to about 12 lb., and in the other from about 9.5 lb. per net ton of ingots to about 8 lb.

That conservation has been effected by changes in deoxidization practices including increasing the amount of manganese added to the ladle and decreasing the quantity added to the furnace; performing partial deoxidation in the furnace with ferrosilicon; and, using spiegel as a substitute for ferromanganese when it was available in sufficient quantity.

Changes in specification limits also assisted in conserving manganese.

Figure 5 shows the effects of manganese conservation and changes in grades in 11 plants and shows clearly how increased amounts of high manganese steels in the past five months have increased manganese consumption to the extent that manganese conservation as illustrated by the period July 1940 to November 1941, has just about been offset by increased production of higher manganese grades. The curve illustrates the necessity for continuing the work on conservation as a means of lengthening out the usable period of our manganese stocks, and increasing the availability of manganese as a substitute for other more critical alloys.

The element silicon is the most plentiful which occurs in the crust of the earth. Unfortunately, it is never found alone in useful form and must be processed in electric furnaces into ferrosilicon to make it suitable for use in steel manufacture. It is used as a deoxidizer and also as an alloying element, sometimes partially replacing chromium as a hardening agent in complex alloy steels. Our supply of ferrosilicon is dependent upon adequate electric power supply.

The unprecedented demand for vanadium for use in high speed steel, and heavy forgings used in armament and in naval propulsion machinery has placed a heavy load on sources of supply. Our supply of vanadium comes very largely from foreign sources. The metallurgists of the steel industry are studying very closely the effects of vanadium with a view toward reducing its use to a minimum wherever possible.

Stotz* reports that a recent series of tests indicate that in high speed tool steel a reduction of 20% in vanadium content will result in a loss of cutting efficiency of only 5 to 8%. Since, in the past, many tools were made from steels too good for the job they had to do, the indicated loss in efficiency may be only of academic interest.

In former times the major portion of our tungsten supply came over the now legendary Burma Road. Work is well under way to increase supplies from domestic sources and from South America but even these increases in supply will not permit unrestricted use of tungsten. Fortunately, industry was able to shift to molybdenum high speed steel with a minimum of discomfort. Moly high speed steels had a background of about 8 years of successful application and in most cases consumers had only to learn new heat-treatment cycles. However, molybdenum is now tight and both elements must be used with care.

For the first time in its history, the steel industry of America faces the threat of a continuing shortage of iron and steel scrap.

The unprecedented tonnage of steel which the industry has produced month after month for the past two years has taxed to the limit the usual sources of scrap. To increase still further the production of steel for the war program, new sources of scrap must be tapped.

Almost four tons of iron ore, coal and limestone are consumed in making one ton of pig iron. Substitution of a ton of scrap for a ton of pig iron thus helps to conserve previous mineral resources, and also lightens the burden upon the nation's transportation system.

Moreover, an open-hearth furnace can produce steel from the usual mixture of half scrap, half pig iron in less

* Stotz, N. I., "Conservation of Elements Necessary for Tool Steels," *A.S.T.M. Bulletin No. 117*, August 1942.

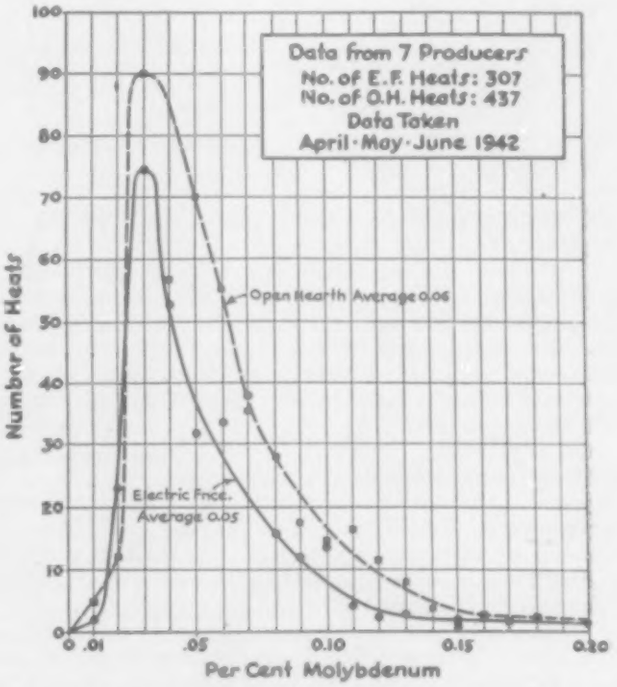


Fig. 6—Residual Molybdenum in Nickel-Chromium Steel

time than would be needed if nothing but pig iron were used. The reason is that scrap is steel which has already been refined.

Electric furnaces which are used to produce the finest grades of steel operate almost entirely upon scrap.

Steel Mills' inventories of scrap iron and steel have shrunk approximately 40% over the past 18 months of record-breaking steel production and now represent an average for the entire steel industry of two or three weeks' supply at the present rate of consumption.

Compared with the total of 3,934,000 tons of scrap on hand at American steel plants on January 1, 1941, the latest figures reveal that on July 1 of this year only 2,429,000 tons of scrap were in the mills' storage yards.

The tonnage on hand at the opening of 1941 was a satisfactory stock, representing over six weeks' supply at the average rate of consumption during 1940. The shrinkage since then has put the steel industry on a hand-to-mouth basis in so far as scrap is concerned, and has

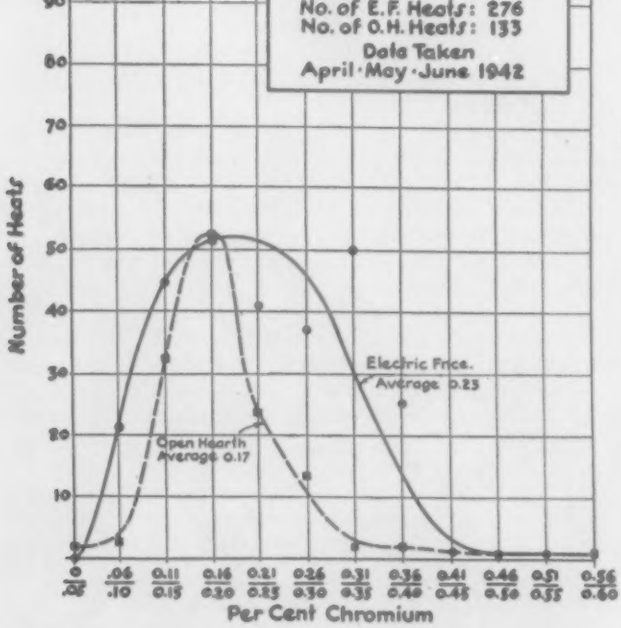


Fig. 7—Residual Chromium in Nickel-Molybdenum Steel

helped to prevent steel production from reaching full capacity.

Ordinarily the steel industry itself produces about 60% of its total scrap requirements, in the form of by-products from its own manufacturing operations. Forty per cent of the scrap needed is purchased from outside sources. So far this year, scrap purchases by steel producers have been at a rate slightly higher than in 1941.

Offsetting this, however, is the fact that the steel industry has been unable to recover quite as much scrap as usual from its own operations. Large exports of steel ingots and semi-finished steel to England and elsewhere have deprived American steel producers of part of one of their major sources of "home" scrap—the croppings from ingots, blooms, etc.

Furthermore, current demands for steel products are heaviest for products like plates, structural shapes and bars, which yield the steel mills less scrap per ton of ingots produced than light products like sheets and strip.

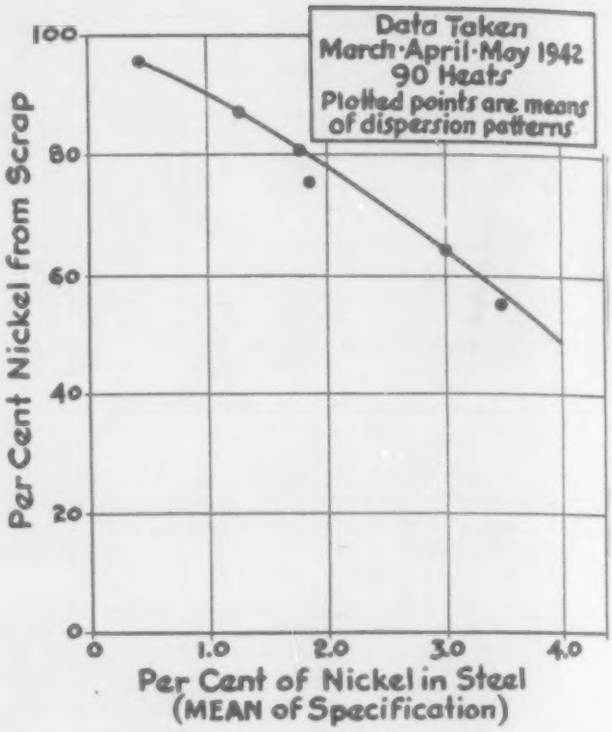


Fig. 8—Recovery of Nickel from Scrap

Despite their inability to secure their full requirements of good quality scrap for steelmaking, steel producers have nevertheless been able to produce more steel in the first half of 1942 than in any previous six-month period on record. This has been accomplished by using a greater than normal proportion of pig iron in steel furnaces, and also by charging large amounts of iron ore into steel furnaces.

Iron ore has long been used in relatively small amounts in steel furnaces, chiefly for its chemical effects in reduc-

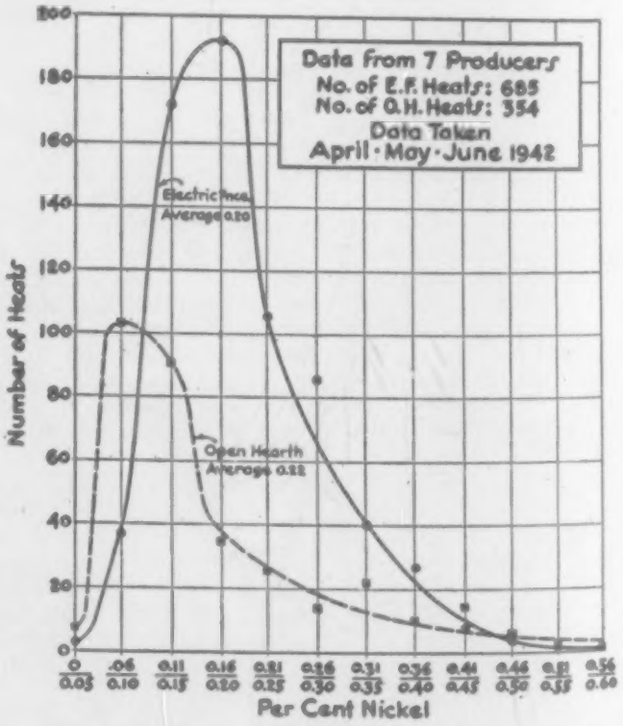


Fig. 9—Residual Nickel in Chromium-Molybdenum Steel

Fig. 10—Sources of Chromium

ing the amount of carbon present in the molten steel. In the present emergency, however, much larger amounts of ore are being used in steel furnaces to provide an additional source of metallic iron.

Reflecting these emergency practices designed to maintain steel production at peak volume despite the scrap shortage, producers of open-hearth steel now are consuming 580 tons of pig iron for every thousand tons of steel they produce, as against their 1941 average of using 557 tons of pig iron per thousand tons of open-hearth steel. Similarly, 46 tons of iron in the form of iron ore and mill scale are now being consumed in the open hearths per thousand tons of steel produced, compared with 42 tons in 1941.

On the other hand, the use of scrap per thousand tons of open-hearth steel produced has declined from 523 tons in 1941 to 507 tons this year. Producers of electric furnace steel have likewise made some changes in their practice. Since scrap is only a minor material in making Bessemer steel, however, there have been no such drastic changes in Bessemer practice.

More than 150,000 tons of badly needed steel scrap will be "mined" this year by one large steel company from slag dumps that have been accumulating at its various plants for as long as half a century.

Every steel plant has its slag dump where molten slag, a by-product of steelmaking, is poured. In former years, "skulls"—the heavy pieces of steel and slag which sometimes solidify in the bottom of ladles—were hauled off to the slag dump along with steel which had overflowed the ladles. There they were buried deeper and deeper beneath the ever-increasing blanket of new slag.

Now that the search for scrap is a major, nation-wide problem, these old slag dumps are being "mined" to recover the steel scrap and feed it back into the furnaces.

The "mining" continues day and night with the aid of batteries of powerful floodlights. Explosives are used to loosen the rock-like slag, then big Diesel-powered shovels burrow into the heap.

When a "deposit" of steel is uncovered, tractors drag it from the pit with chains. The chunks are broken up or cut into pieces by torches, then charged into the furnaces.

But steel scrap is not only important because of the iron it contains. It is a major source of supply of the alloying elements nickel, chromium and molybdenum. The ever-increasing quantities of alloy steels which are being put to use in the manufacture of the weapons of war, coupled with inadequate methods of segregating scrap according to its chemical compositions have brought about a condition which makes it virtually impossible to produce a chromium-nickel steel without a substantial quantity of molybdenum, a nickel-molybdenum steel without a substantial content of chromium or a chromium-molybdenum steel without a substantial quantity of nickel. In any event, a waste of the incidental alloy occurs because the physical properties of the steel have been increased beyond the expectations of the designing engineer and the heat-treatment cycles employed are not designed to bring out the maximum potentialities of the steel.

Figure 6 shows the incidence of molybdenum in nickel-chromium steel. Although the incidental content of molybdenum is most commonly 0.03%, the average is 0.05 for electric furnace steel and 0.06% for open-hearth steel, and many heats contain far more substantial amounts. Both curves are skewed to the left, a statistical indication that both mode and average are on the increase.

Figure 7 shows the incidence of chromium in nickel-molybdenum steel. Again the incidental content most commonly found is high enough to influence markedly the physical properties of the steel and again the curves are skewed to the left, indicating that the mode and average are on the increase.

In the case of nickel, larger quantities are available from scrap because nickel is not oxidizable in the steelmaking process and relatively larger amounts are recovered. The experience of one large producer of nickel steel is summarized in Fig. 8.

It is to be noted that in the field of low nickel steels whether of simple or complex composition more than 90% of the nickel called for by specification ranges is being recovered from steel scrap. In order to make that possible, most rigid control of scrap originating in the steel mill and purchased scrap was necessary.

In spite of such control the admixture of elements has occurred to such a degree that the incidental nickel contained in chromium-molybdenum steel averages 0.20% in the electric furnace and 0.22% in the open hearth. The left hand skew is marked in this chart and we shall see later that the indication of increase has been proved.

Those facts relative to amounts of alloying elements contained in scrap coupled with an almost constant (or possibly diminishing) supply of alloys in the face of rapidly expanding demands for alloy steel led to the promulgation of the NE 8000 series steels containing an average content of 0.50% nickel, 0.50% chromium and 0.25% molybdenum.

Chromium is one of the most important strategic materials both because of its essential uses, for which there are no satisfactory substitutes, and because practically all of this material must be imported.

Its uses are of three general types: metallurgical, refractory and chemical. The steel industry normally uses three-fourths of the total either in alloy steel or in refractory brick.

Remaining foreign sources of supply are particularly vulnerable as Fig. 10 shows. Fortunately, new chro-

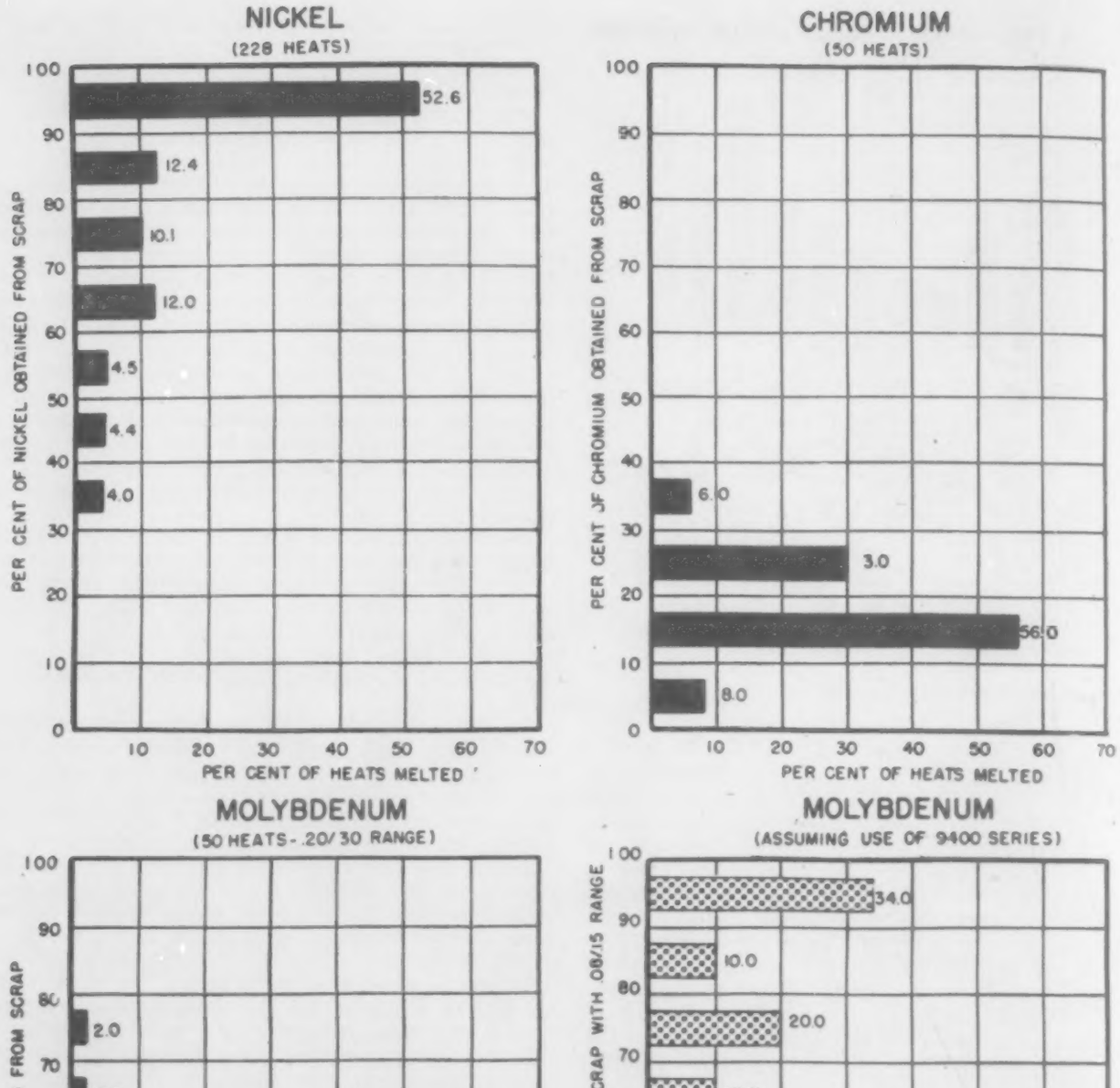


Fig. 11—NE Steels 8600–8900 Alloys Obtained from Scrap

mium deposits have been discovered which should not be disturbed by happenings outside the Western Hemisphere but until those sources produce, further conservation will be necessary.

Nickel and molybdenum are secured wholly from our own continent, the former from Canada and the latter from within the United States. Both elements have been drawn on to an unprecedented extent but it has been only in recent months that molybdenum has become critical.

Molybdenum is the "roving center" of alloying elements. Alone, in a carbon-molybdenum steel it does an excellent job of increasing hardenability, tensile strength at both normal and elevated temperatures and resistance to high temperature creep. In combination with other elements, it not only confers its individual benefits, but "backs up" the other elements, enhancing their desirable properties and inhibiting their undesirable properties. For those reasons, as well as because of availability, molybdenum has been used to replace tungsten in tool steels and to replace nickel and chromium in construc-

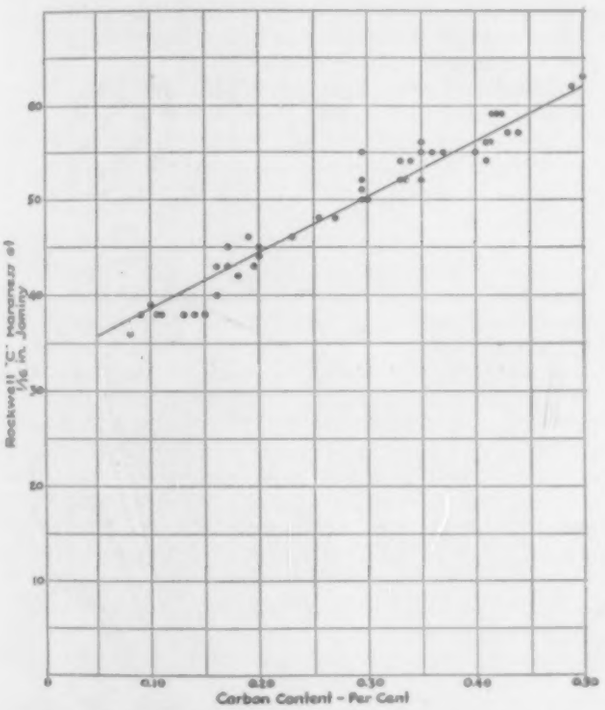


Fig. 12—Relationship Between Subsurface Hardness and Carbon Content of NE Steels

tional alloy steels. As a result our supply of molybdenum has been overworked and is temporarily "tight."

Nickel, one of the most versatile of all the alloying elements, has been under restrictions for some time. However, supplies are increasing somewhat and more effective use is being made of the quantities which are available. Even Monel metal scrap, unsuitable for use in Monel metal production, is being used effectively by the steel industry to produce a copper-nickel-chromium steel containing about 1.00% nickel, 0.25% copper and 0.70% chromium. In practice that steel has been found to be equal in strength and hardness to A 3140 and superior in ductility and notched-bar sensitivity.

Since the NE 8000 series of steels was announced, the war effort has made even greater demands upon our supply of alloys and it has become necessary to cut the quantities of nickel, chromium and molybdenum steel further. The NE 9400, 9500 and 9600 series do that job

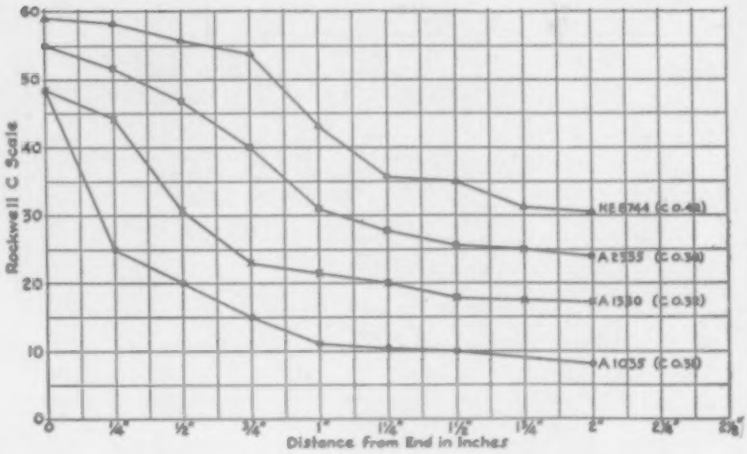


Fig. 13—Effect of Carbon and Alloying Elements on Hardenability

effectively, since they contain an average of 0.30% nickel, 0.30% chromium and 0.15% molybdenum.

The following charts show the quantities of alloying elements obtained from scrap in producing the NE 8600, 8700 and 8900 series steels. The recovery of nickel is greatest as would be expected because nickel does not oxidize in melting and the recovery of chromium is lowest because it is easily oxidized in the open hearth. The percentage of molybdenum recovered is impressive because NE steels have been in production only since May of this year.

Figure 11 is significant because it shows the very great savings in molybdenum which can be made through the use of the NE 9400 series steels.

Let us now examine some of the metallurgical concepts which were used in devising these lean alloy steels.

In devising all the compositions which are now known as NE steels, consideration was given to the effects of the several elements and the well-known principle that if two elements are equally effective, a greater hardenability

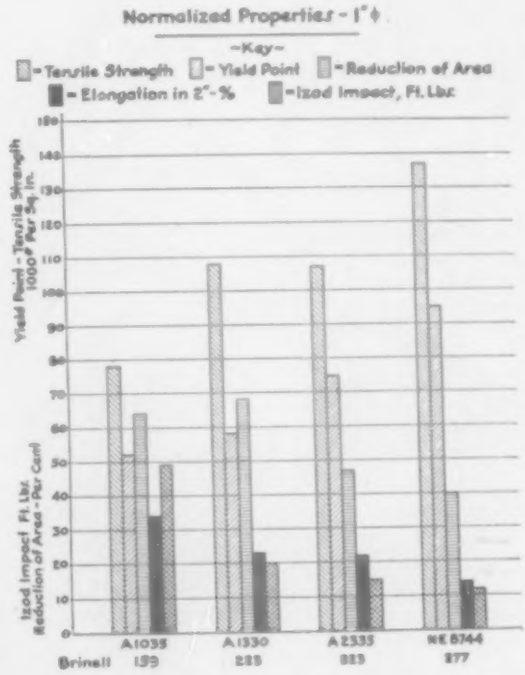


Fig. 14—Comparative Physical Properties—Effects of Carbon and Alloying Elements

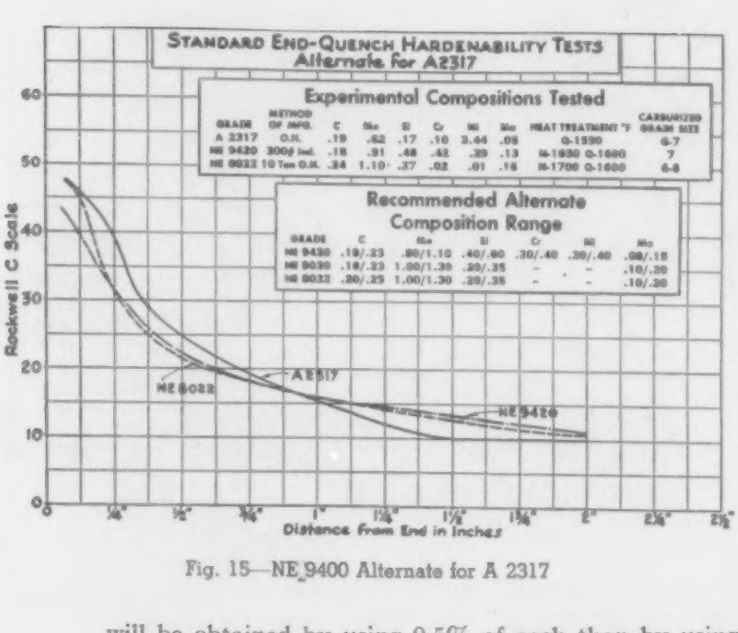


Fig. 15—NE 9400 Alternate for A 2317

will be obtained by using 0.5% of each than by using 1.0% of either of them alone. Hardness is related to tensile strength, yield point and ductility as measured by reduction of area and elongation, and regardless of composition, steels of the same hardness, produced by tempering after hardening, will have the same tensile strength and yield point, provided that the original quenched structure is substantially martensitic.

That reference to the microstructure of steel merits some consideration here because for many years we have discussed chemical composition as the major criterion of performance, and many people are under the impression that because NE steels are lean in alloys they are "different."

The two principal components of the microstructure of steel, whether carbon or alloy, are ferrite and carbide. The physical properties of steel are controlled by the microstructure which portrays the quantity of each component present and its distribution or dispersion.

Changing the microstructure of steel is the art of heat treatment. To secure certain desired properties steel is heated above a certain critical temperature at which its molecular structure changes, carbon and other carbide-forming elements such as chromium and molybdenum are dissolved and a solid solution of carbides in ferrite called austenite is formed.

If the hot steel is now suddenly cooled, or quenched as it is called, the austenite is transformed and a new component called martensite is formed. Martensite is a mechanical mixture of carbides and ferrite in a fine state of dispersion—the more rapid the cooling the finer the dispersion, and the harder the product. The cooling rate which just results in complete transformation of austenite to martensite or complete hardening, is known as the critical cooling rate.

Since martensite is brittle a second heating and cooling called tempering is necessary to impart toughness. The tempering operation consists in heating steel to a predetermined temperature lower than the quenching temperature which will adjust the distribution of the carbides in the ferrite to form a coarser microstructure than that exhibited by martensite. This coarser structure is somewhat softer (less strong) and much more ductile than martensite. It is the structure present when the steel is put into service.

The foregoing explanation was based upon treating a piece of steel which was small enough to be cooled all the way through its cross section at a rate equal to or in excess of the critical cooling rate; that is, the piece was hardened all the way through. If the section was so large that this could not happen then only that part of the austenite on the periphery of the piece would be transformed to martensite; the balance would be transformed to pearlite, a coarse mixture of carbides and ferrite and would gradually merge into the hardened martensite zone. Obviously then, the steel has not been hardened through and will not exhibit the superior physical properties of a steel which has been hardened throughout.

Our problem now is to induce the steel to harden throughout its cross section. This is done by the use of the alloying elements manganese, nickel, chromium, silicon and molybdenum. All those elements lower the critical cooling rate, although not all are effective to the same degree, and permit the steel to harden to greater depths.

The influence of the alloying elements in performing this most useful function is probably threefold: (1) they change the distribution of the carbides in the ferrite matrix by reason of difference in volume; (2) they change the properties of the ferrite by dissolving in it; and (3) they change the quality of type of carbide as compared with iron carbide or cementite.

This elementary explanation is given simply to point out the fact that NE steels follow rigidly the pattern set by nature for all other types of constructional steels and to emphasize the fact that microstructure is of major importance in securing most of the desired mechanical properties.

It is a fundamental fact that the maximum hardness which a given steel can attain by proper heat treatment is dependent almost entirely on its carbon content, while depth of hardness is largely dependent upon its content of alloying elements.

In this respect the NE steels react precisely the same as do the standard steels of the past. Figure 12 shows the hardness of 45 NE steels at $^1/_{16}$ in. on the Jominy bar plotted as a function of carbon content. It is significant that the curvilinear relationship of theory and research is maintained even though the data were taken from commercial tests which were run on commercial heats, and that all types of NE steels are represented.

The standard end-quench hardenability tests given in Fig. 13 illustrate clearly the principles (1) that maximum hardness is a function of carbon, (2) that depth of hardness is a function of alloying elements and (3) that small

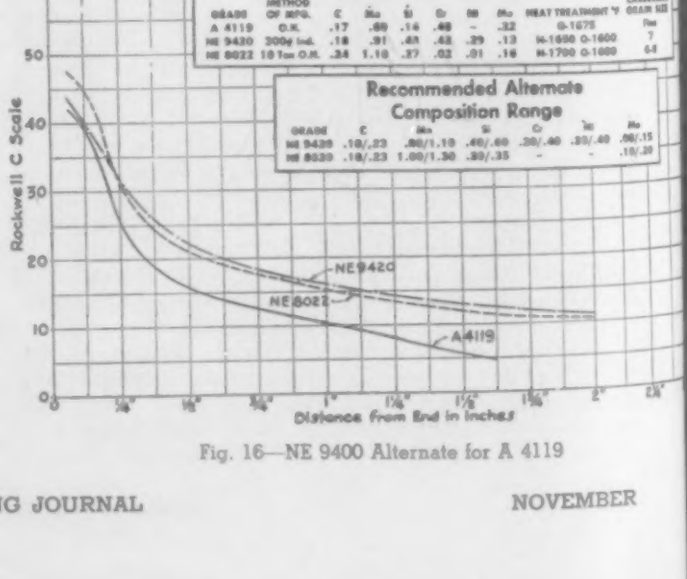


Fig. 16—NE 9400 Alternate for A 4119

quantities of several properly selected elements are more effective in influencing hardenability than a large quantity of a single element.

The curve for A 1035 is typical of a carbon steel; it identifies a shallow-hardening steel by reason of the low Rockwell values at 1/4 in. and beyond. The curve for A 1330 illustrates first, the maximum hardening power of carbon uninfluenced by alloying elements and, second, the influence of an alloying element, in this case manganese, in increasing depth of hardness. The manganese content of A 1035 was 0.78% while that of the A 1330 was 1.82%; the carbon contents of the two steels were practically identical.

The curve for A 2335 illustrates the increased maximum hardness due to increased carbon and the increased depth of hardness due to 3.5% nickel. The curve for NE 8744 further illustrates maximum hardness due to carbon and also shows the hardening power of small quantities of several properly selected alloying elements. The alloy content of the NE 8744 was manganese 0.85%, nickel 0.50%, chromium 0.51% and molybdenum 0.23%.

Mechanical property data for one-inch round bars of all the steels under discussion are available and examination shows that the standard end-quench hardenability curves accurately portrayed the facts.

The NE 9400 series steels react in a like manner as may be seen from the following standard end-quench hardenability curves.

Where this program of conservation will end, no man can tell. It is evident, however, that having been put on our mettle to do more with less, a permanent effect will be a more alert approach to all such problems. Some of these new steels will become the standards of the future. We have seen that there have been developed steels containing hitherto unused ranges in chromium and molybdenum. Manganese-chromium, manganese-chromium-silicon, manganese-molybdenum, silicon-molybdenum, copper-chromium-nickel and copper-molybdenum steels have been developed which were almost unknown six months ago. We realize, too, more than ever before, that no one knows all there is to know about any single steel composition. Carbon steels have been satisfactorily substituted on jobs where it was always thought an alloy steel was indispensable, and Bessemer steels are being substituted for open-hearth steels.

All our efforts must be devoted to the main job in hand—to do more with less. The necessary amount of scrap must be secured and the National Emergency steels must be used to ensure the success of our war effort.

With reference to the NE steels, a quatrain from Omar Khayyam is apropos:

> "Before the phantom of False morning died,
> Methought a Voice within the Tavern cried,
> 'When all the Temple is prepared within,
> Why nods the drowsy Worshipper outside?'"

Construction of Globe Valves by Arc Welding*

By H. C. Elliott†

CASTING of globe valves has long been a time-taking and laborious task. Cores must first be made and cured; then molds made and poured. Next, the casting is allowed to cool—and the gates burned out. Finally, the casting is ground, chipped and inspected for flaws. Flaws are corrected by arc welding.

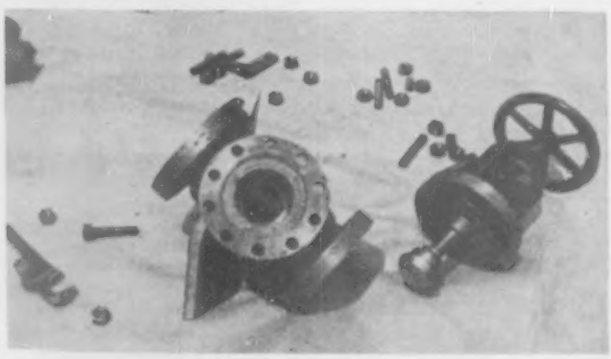


Fig. 1—Parts of Valve

To speed up manufacture of globe valves and to improve the quality of the valves all sizes from 2 in. up can be made for all pressures by welded construction of tubing, plates and bars. No special setup is necessary for tubing manufacturers to produce these valves on a production line basis since wall thicknesses can be selected from standard sizes. Four and one-fourth inch tubing is now made in 19 wall thicknesses varying from

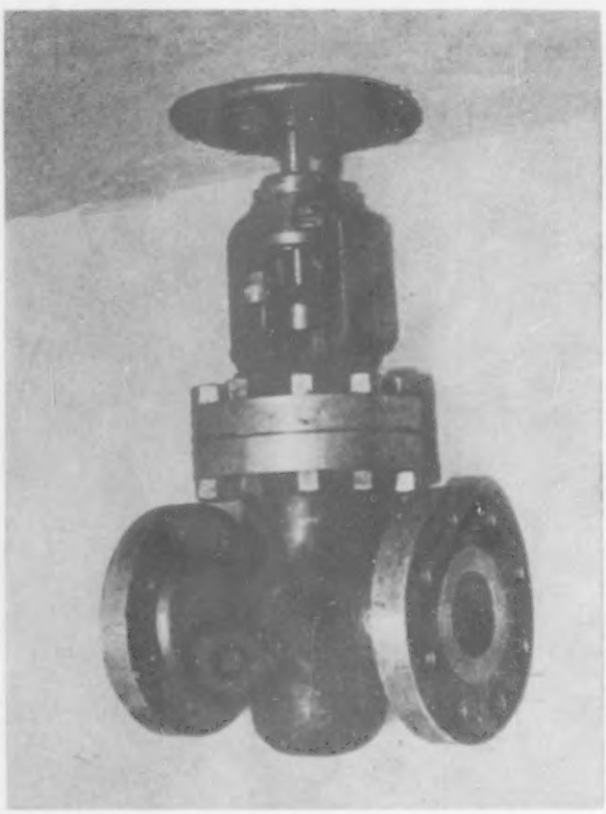


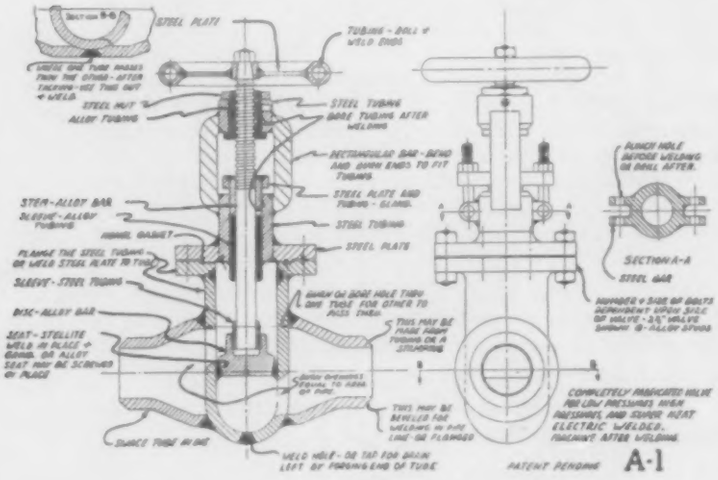
Fig. 2—Completed Valve

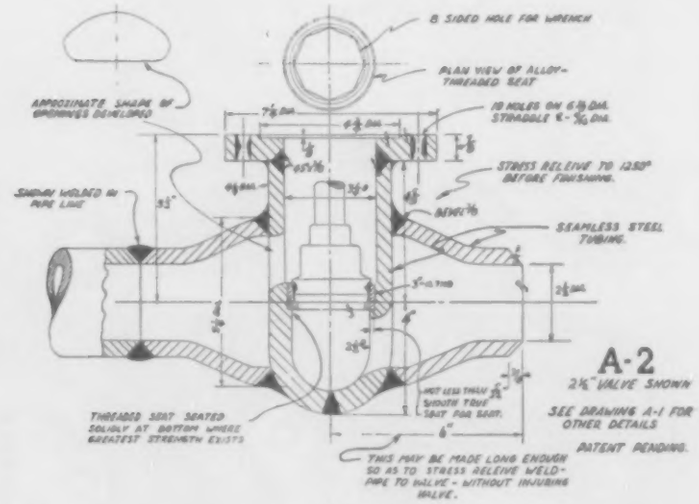
* Hobart Monthly Arc Welding Contest Winner. Photographs and drawings courtesy Hobart Brothers, Troy, O.

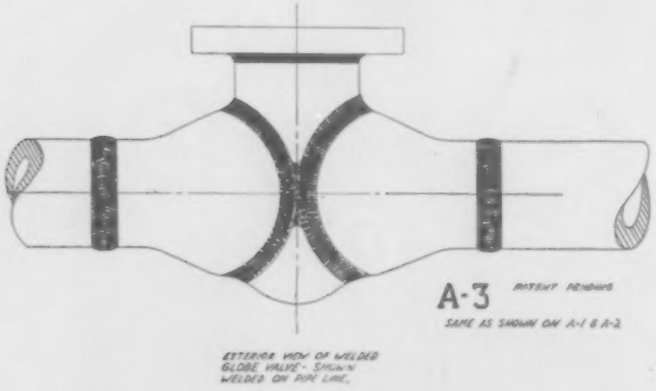
† Mississippi Valley Barge Line Co.

16 gage to $1^1/_8$-in walls. Five-inch tubing is made in 17 different wall thicknesses—varying from 11 gage to 1 in. thick.

S.A.E. 1035 steel tubing has much better physicals than cast steel.




8 SIDED HOLE FOR WRENCH
PLAN VIEW OF ALLOY-THREADED SEAT
10 HOLES ON 6⅛ DIA.
STRADDLE ⅝ - ⅞ DIA.
STRESS RELEIVE TO 1250° BEFORE FINISHING.
SEAMLESS STEEL TUBING.
THREADED SEAT SEATED SOLIDLY AT BOTTOM WHERE GREATEST STRENGTH EXISTS
THIS MAY BE MADE LONG ENOUGH SO AS TO STRESS RELEIVE WELD - PIPE TO VALVE - WITHOUT INJURING VALVE.
A-2
2½" VALVE SHOWN
SEE DRAWING A-1 FOR OTHER DETAILS
PATENT PENDING.



S.A.E. 1035 steel welds better than any of the S.A.E. carbon steels. A valve body made from this tubing and stress relieved after welding would be almost equal to 6% chrome-0.05% molybdenum heat-treated steel castings.

	Tubing	Cast Steel
Tensile strength, psi.	103,000	74,000
Yield point, psi.	78,000	38,000
Elongation in 2 in., %	24	24
Reduction of area, %	62	35

Drawings show method of constructing a $2^1/_2$-in. high-pressure valve by arc welding. First, the transverse tube was sawed to the right length and a blacksmith swaged the ends. A large hole was burned vertically through the tubing, leaving $^1/_4$ in. for boring. Next, a machinist chucked the tubing and bored a hole through it so that the vertical tube would slip in it. Since the horizontal tube is only $^3/_8$ in. larger in diameter than the vertical tube, the horizontal tube has just enough metal left to hold the two valves together after boring through it. But that small amount of metal is burned out after tacking together. (See upper left-hand corner of drawing A-1.)

The vertical tube was sawed to the correct length and the top layer of Monel weld put in for the seat. Then the tube was turned on its other end and the rest of the bead run. With careful welding, this bead can be run without pinholes and flaws with Monel, stainless, stellite, bronze or mild steel electrodes.

Next, a templet was made to wrap around the vertical tube. This laid off the two slots for the inlet and outlet of the valve. These slots were burned neatly and trimmed with an air chipping hammer. The bottom of this tube was closed and it was slipped into the horizontal tube for welding. Welding details are shown on all of the drawings.

Welded tubes were chucked up and the top of the vertical tube and ends of the horizontal tube faced and chamfered for welding. Next, top plate and flanges were welded on. Now the body was ready for final machining which consisted of the following operations:

(*a*) Facing three flanges (as shown).
(*b*) Truing inside welds.
(*c*) Machining seat to proper angle.
(*d*) Drilling bolt holes.

The bonnet of the valve was welded in a simple fixture which held the tubing, plates and bars in position while being tacked and while final beads were run—bonnet required no preliminary machining of parts. It was chucked up only once for final facing of the bottom flange, boring of the two pieces of tubing, and facing the tubing at three places.

Packing gland consists of one piece of tubing with a plate welded to one end and machined to fit. Stem guide was made from stainless steel tubing and held in place by a light weld bead of Monel. The valve stem and disk is Monel—both of conventional design.

Using same rates of labor costs and overhead figures, a welded valve can be built for 52% less than a cast-steel valve. A cast-steel valve (standard $2^1/_2$ in.) weighs 200 lb. Similar valve of welded steel weighs only 100 lb. This $2^1/_2$-in. welded globe valve is good for a working pressure of 1500 lb. and a total temperature of 750° F. It was tested by hydraulic pressure to 5500 psi. The American Bureau of Shipping has approved this design as practical for valves for steam power plant equipment. Patent is pending on the method of construction and design.

All Steel Emergency Stretchers*

By Francis W. Klay†

AN excellent way for those of us at home to get into the scrap is to make use of our scrap material. For instance, here is an easy and economical plan to construct emergency stretchers from second hand steam pipe. My classes in sheet metal and welding have constructed a total of 90 of these stretchers for the local Red Cross, war plants, hospitals and State Guard units. Total weight of this welded stretcher is only 25 lb.

Materials needed are:

2—$^3/_4$-in. pipes 84 in. long.
2—$^3/_4$-in. pipes 21 in. long.
4—$^3/_4$-in. pipes $4^3/_4$ in. long.
4—$^1/_4$-in. rods "U" bends.
2—$^1/_4$-in. rods 71 in. long.
4—grommets.
18—No. 9 galvanized wire hooks.
1—Army duck canvas, 28 in. × 78 in. × 10 oz.

* A prize winner in Hobart's Arc Welding News Contest. (Photographs and drawings, courtesy Hobart Brothers, Troy, Ohio.
† Northampton Vocational School.

Fig. 2

First make four half rings of $^1/_4$-in. pipe by placing a short piece of $^5/_8$-in. pipe in a vise and winding the smaller pipe around it, using a large pair of gas pliers. Then hacksaw down through the center of this bent pipe making a number of half rings at a time. Weld these "U's" to the 84 in. long pipe 5 in. from each end (see drawing).

Second, make a metal miter pattern for the stretcher legs and cross braces; mark and grind out on a rounded emery wheel.

In order to tack weld the legs of $^3/_4 \times 4^3/_4$ in. and

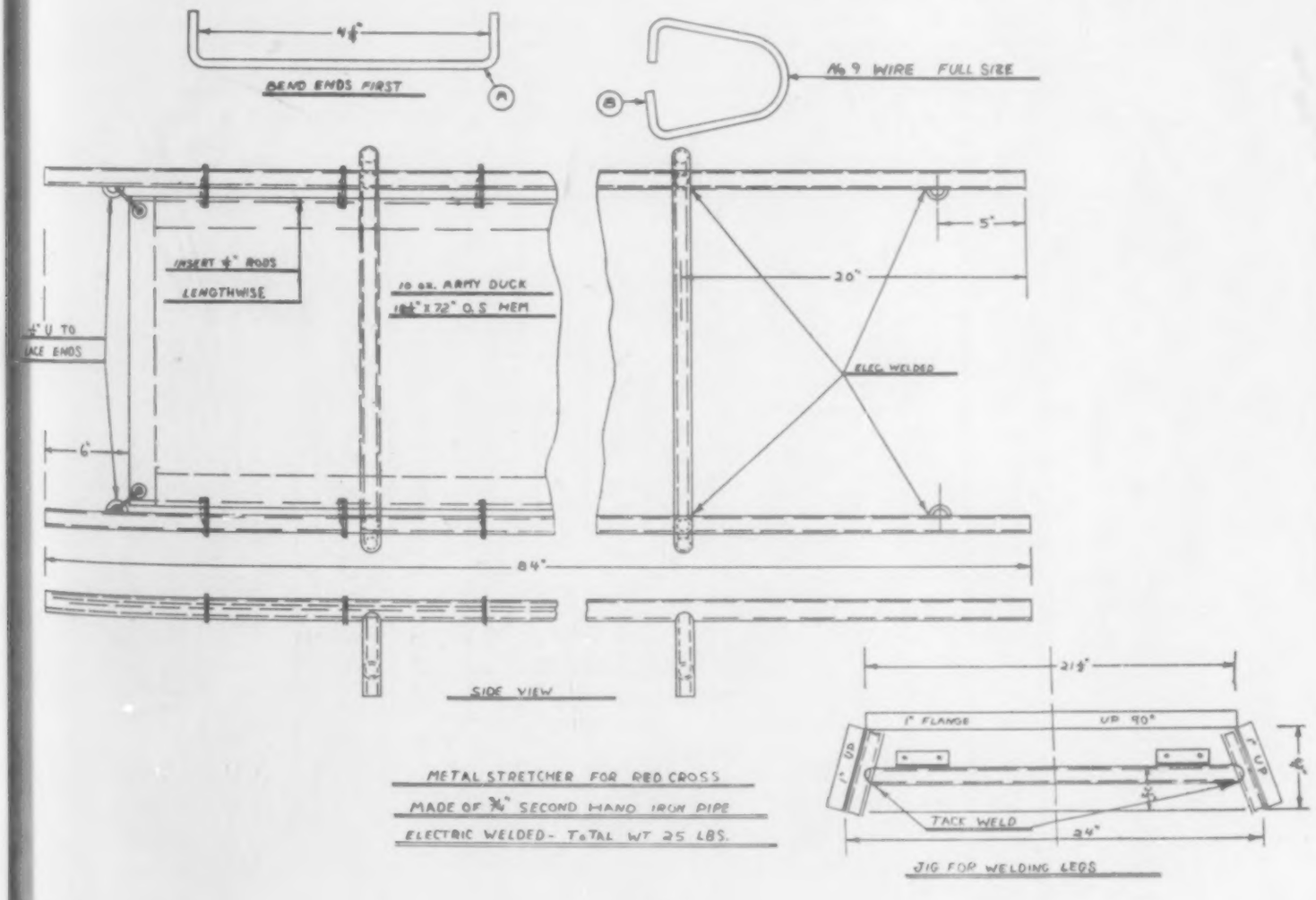


Fig. 1

center braces of $^3/_4 \times 21$-in. pipe together, make the simple jig of sheet metal shown in the drawing. For fast construction, a wooden form can be made, as shown in the photo, for squaring, holding legs in position and welding on long pipe. All welds were made with $^3/_{32}$-in. mild steel rod.

Ten-oz. Army duck 28 in. wide and 78 in. long is used for the covering. Instruct the awning shop to fold sides three times to $18^1/_2$ in. wide outside with $1^1/_2$-in. hems at ends. Stitch and put grommets in each corner as shown in the drawing. Leave ends open to insert long $^1/_4$-in. pieces.

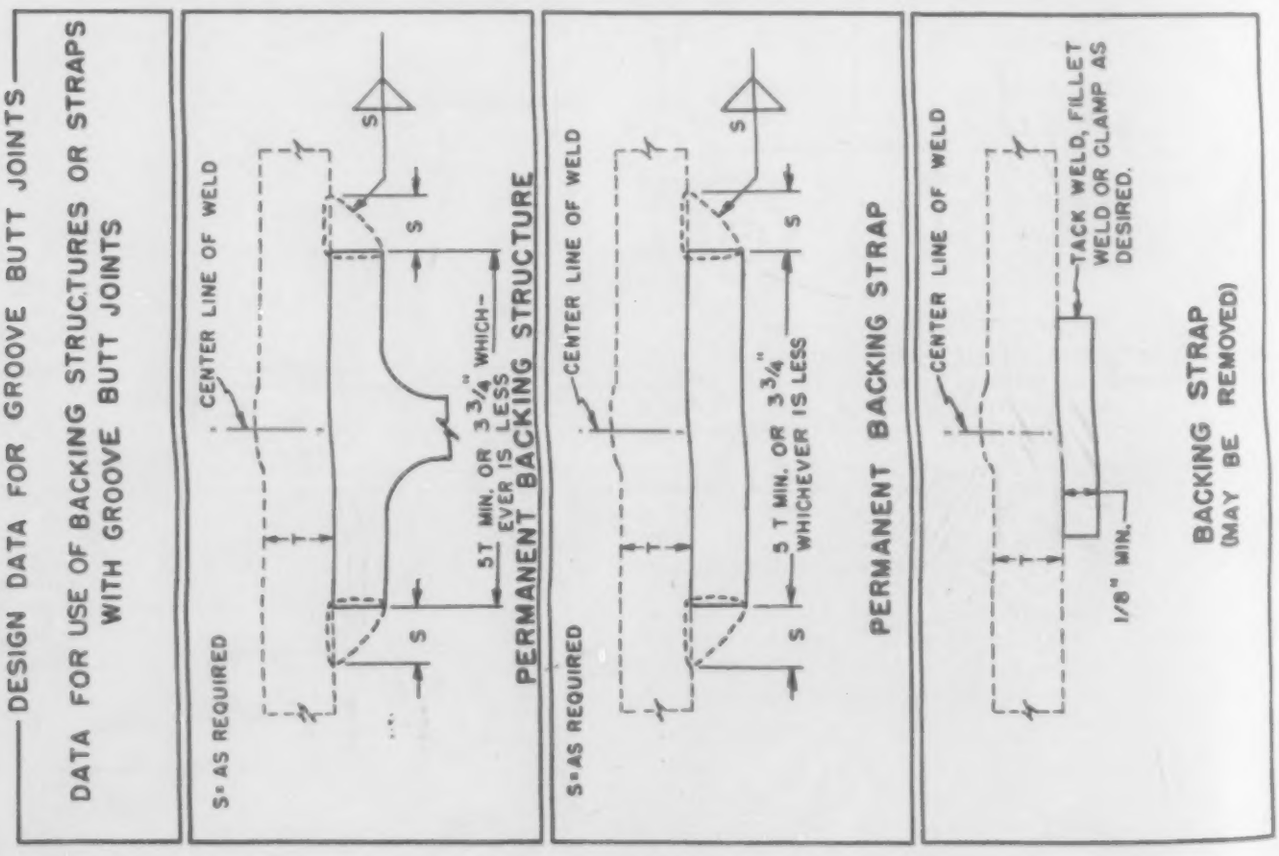
To fit the canvas, fit the painted $^1/_4$-in. pipe into the canvas hems, lacing each corner tight with heavy marline. Next, cut 18 pieces of No. 9 galvanized wire $5^3/_4$ in. long. Bend this wire into hooks exactly as shown in the drawing. Make holes in the canvas with a long tapering drift pin close to the inside pipe inserted in the canvas hem. Then squeeze the hooks to the pipe with large gas pliers. Start from the center and work from one side to the other toward each end.

Job shops, vocational classes, metal shops or anyone owning an arc welder will find these stretchers easy and economical to construct from scrap materials. Suggest this plan to the proper authority in your community if additional or new stretchers are needed.

Design of Joints for Arc and Gas Welding Processes

Foreword

THE joints indicated below have been prepared by a Subcommittee of the Marine Committee of the AMERICAN WELDING SOCIETY. They are being published for the purpose of securing comments and criticisms. It is not intended to imply that these are the only types of joints which may be used in marine construction. The joints shown are, however, generally used and recognized as acceptable. To be effective, comments should be received by January 15, 1943. Communications should be addressed to Marine Committee, AMERICAN WELDING SOCIETY, 33 West 39th Street, New York City.


DESIGN DATA FOR GROOVE BUTT JOINTS
DATA FOR USE OF BACKING STRUCTURES OR STRAPS WITH GROOVE BUTT JOINTS
CENTER LINE OF WELD
S= AS REQUIRED
S
T
5T MIN. OR 3 3/4" WHICHEVER IS LESS
PERMANENT BACKING STRUCTURE
PERMANENT BACKING STRAP
TACK WELD, FILLET WELD OR CLAMP AS DESIRED.
1/8" MIN.
BACKING STRAP (MAY BE REMOVED)

DESIGN DATA FOR GROOVE BUTT JOINTS

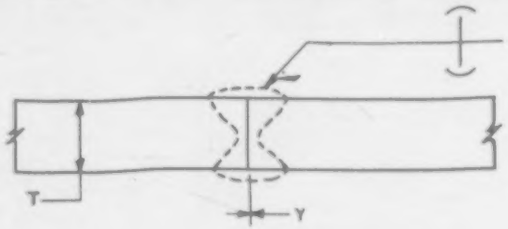
IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

NOTES:

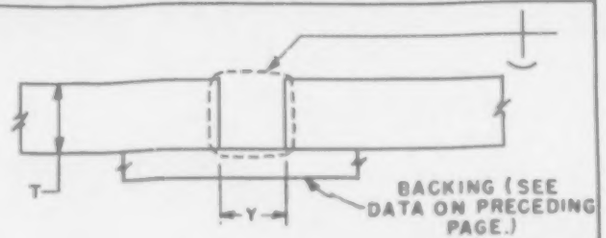
1. REINFORCEMENT OF WELD SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.

JOINT NUMBER	DIM. T MAX.	Y ROOT OPENING	SEE NOTES	POSITION OF WELDING USED				DIMENSION Y REQUIRED ON SYMBOL
				FLAT	VERT	OVER	HOR'L	
B-2	1/8"	0" TO T	1	✓	✓	✓	✓	
B-5	1/4"	1/2 T MIN.	1 & 2	✓	✓	✓	✓	✓
B-3	3/16"	T MIN.	1	✓	✓	✓	✓	✓

JOINT NUMBER B-2, B-5 — SQ. BUTT JOINT, WELDED BOTH SIDES



JOINT NUMBER B-3 — SQ. BUTT JOINT, WELDED ON BACKING



DESIGN DATA FOR GROOVE BUTT JOINTS

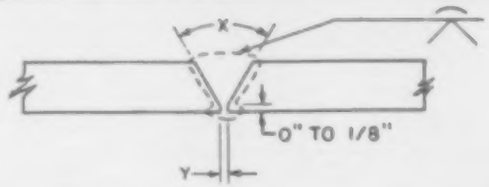
IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

NOTES:

1. REINFORCMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. ROOT EDGES SHALL BE INDEPENDENTLY FUSED TO BACKING WITH 5/32" DIAMETER ELECTRODES.

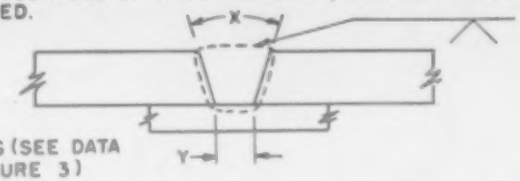
JOINT NUMBER	ANGLE X MIN.	Y ROOT OPENING.	SEE NOTES	POSITIONS OF WELDING USED.				DIM. REQ'D. ON SYMBOL	
				FLAT	VERT	OVER	HOR'L	.X	"Y"
B-14	60°	1/8" TO 1/4"	1 & 2	✓	✓	✓	✓		
B-11	45°	1/4"	1	✓	✓	✓	✓	✓	
B-41	20°	1/2"	1 & 3	✓	✓	✓		✓	
B-46	12°	1/2"	1 & 3	✓				✓	
B-31	60°	1/8" TO 1/4"	1 & 2	✓	✓	✓	✓		

JOINT NUMBER B-14 — SINGLE-V BUTT JOINT, WELDED BOTH SIDES

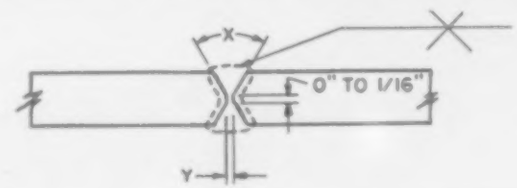


JOINT NUMBER B-11, B-41, B-46 — SINGLE-V BUTT JOINT, WELDED ON BACKING

WHERE POSITIONS OF WELDING PERMIT, SMALLEST ANGLE SHOULD BE USED.



JOINT NUMBER B-31 — DOUBLE-V BUTT JOINT, WELDED BOTH SIDES



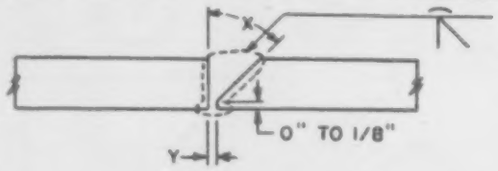
DESIGN DATA FOR GROOVE BUTT JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

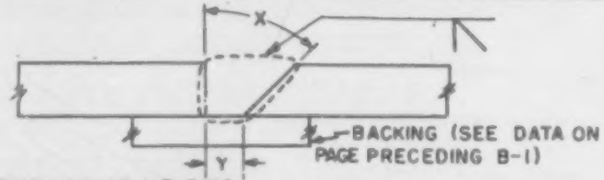
NOTES:
1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. NO STRUCTURE WHICH OBSTRUCTS THE OPERATORS VISION OF THE ROOT OF THE WELD SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE UNBEVELED PLATE.
4. WHEN THIS JOINT IS WELDED IN THE FLAT & OVERHEAD POSITIONS OF WELDING NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE JOINT. WHEN WELDED IN OTHER POSITIONS NO OBSTRUCTION SHALL BE CLOSER THAN 18 INCHES.

JOINT NUMBER	ANGLE X MIN.	DIMENSION Y	SEE NOTES	POSITIONS OF WELDING USED				DIM. REQ'D. ON SYMBOL	
				FLAT	VERT.	OVER.	HOR'L	X	Y
B-17	45°	1/8" TO 1/4"	1, 2 & 4	✓	✓	✓	✓		✓
B-15	45°	1/4" MIN.	1 & 4	✓	✓	✓	✓		
B-21	35°	3/8" MIN.	1 & 4	✓	✓	✓	✓	✓	
B-18	25°	3/8" MIN.	1, 3 & 4	✓	✓	✓		✓	
B-32	45°	1/8" TO 1/4"	1, 2 & 4	✓	✓	✓	✓		

JOINT NUMBER B-17 — SINGLE-BEVEL BUTT JOINT, WELDED BOTH SIDES.

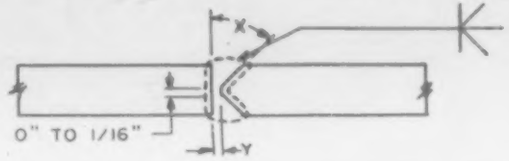


JOINT NUMBER B-15, B-21, B-18 — SINGLE-BEVEL BUTT JOINT, WELDED ON BACKING



WHERE POSITIONS OF WELDING PERMIT SMALLEST ANGLE SHOULD BE USED.

JOINT NUMBER B-32 — DOUBLE-BEVEL BUTT JOINT, WELDED BOTH SIDES.



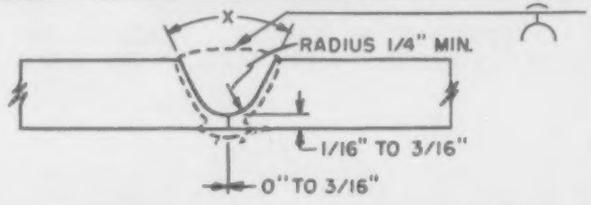
DESIGN DATA FOR GROOVE BUTT JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

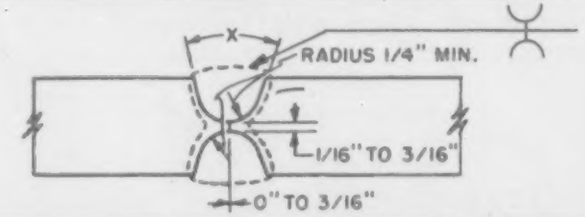
NOTES:
1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. WHERE POSITIONS OF WELDING PERMIT, SMALLEST ANGLE SHALL BE USED.

JOINT NUMBERS	ANGLE X MIN.	SEE NOTES	POSITIONS OF WELDING USED				ANGLE X REQ'D. ON SYMBOL
			FLAT	VERT.	OVER.	HOR'L	
B-43, B-61 AND B-68	45°	1, 2 & 3	✓	✓	✓	✓	✓
B-47, B-63 AND B-64	20°	1, 2 & 3	✓	✓	✓		
B-48	12°	1, 2 & 3	✓				✓

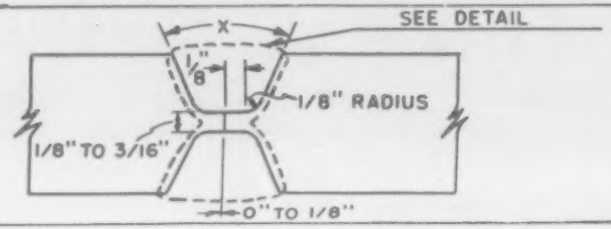
JOINT NUMBER B-43, B-47, B-48 — SINGLE-U BUTT JOINT, WELDED BOTH SIDES



JOINT NUMBER B-61, B-63 — DOUBLE-U BUTT JOINT



JOINT NUMBER B-68, B-64 — DOUBLE-U BUTT JOINT (MODIFIED)



DESIGN DATA FOR GROOVE BUTT JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

NOTES:
1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. WHERE POSITIONS OF WELDING PERMIT, SMALLEST ANGLE SHALL BE USED.

JOINT NUMBERS	ANGLE X MIN.	SEE NOTES	POSITIONS OF WELDING USED				ANGLE X REQ'D. ON SYMBOL
			FLAT	VERT.	OVER.	HOR'L	
B-43, B-61 AND B-68	45°	1, 2 & 3	✓	✓	✓	✓	✓
B-47, B-63 AND B-64	20°	1, 2 & 3	✓	✓	✓		
B-48	12°	1, 2 & 3	✓				✓

JOINT NUMBER B-43, B-47, B-48 — SINGLE-U BUTT JOINT, WELDED BOTH SIDES

JOINT NUMBER B-61, B-63 — DOUBLE-U BUTT JOINT

JOINT NUMBER B-68, B-64 — DOUBLE-U BUTT JOINT (MODIFIED)

DESIGN DATA FOR GROOVE CORNER JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

DESIGN DATA FOR GROOVE BUTT JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS REFERENCED IN TABLE.

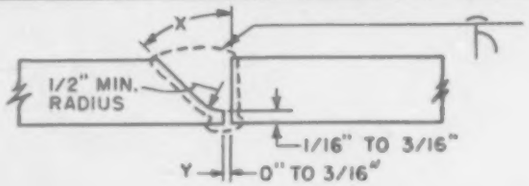
NOTES:

1. REINFORCMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. WHEN THIS JOINT IS WELDED IN THE FLAT & OVERHEAD POSITIONS NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE JOINT. WHEN WELDED IN OTHER POSITIONS NO OBSTRUCTION SHALL BE CLOSER THAN 18 INCHES.
4. NO STRUCTURE WHICH OBSTRUCTS THE OPERATORS VISION OF THE ROOT OF THE WELD SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE UNBEVELED PLATE.

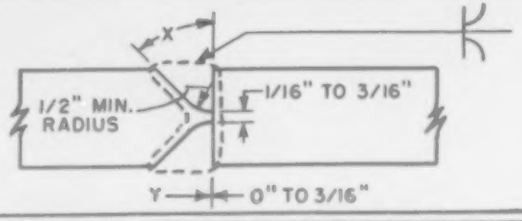
WHERE POSITIONS OF WELDING PERMIT, SMALLEST ANGLE SHALL BE USED.

JOINT NUMBER	ANGLE X MIN.	SEE NOTES	POSITIONS OF WELDING USED				DIM. REQ'D. ON SYMBOL	
			FLAT	VERT.	OVER.	HOR'L	X	Y
B-45, B-65 & B-66	35°	1, 2 & 3	✓	✓	✓	✓		
B-44, B-62 & B-67	25°	1, 2, 3 & 4	✓	✓	✓		✓	

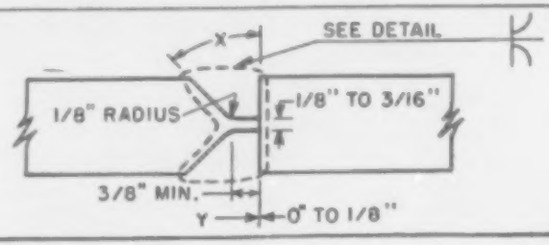
JOINT NUMBER B-44, B-45 — SINGLE-J BUTT JOINT, WELDED BOTH SIDES



JOINT NUMBER B-62, B-65 — DOUBLE-J BUTT JOINT



JOINT NUMBER B-66, B-67 — DOUBLE-J BUTT JOINT (MODIFIED)



DESIGN DATA FOR GROOVE CORNER JOINTS

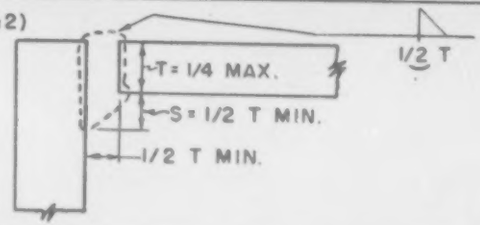
IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

NOTES:

1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. S = AS REQUIRED.

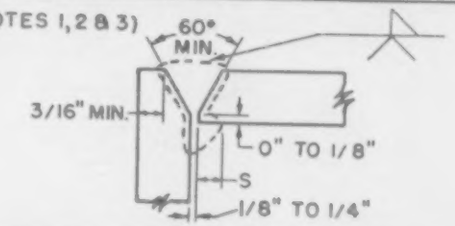
OPEN SQ. CORNER JOINT, WELDED BOTH SIDES.

C-2 (SEE NOTES 1 & 2)



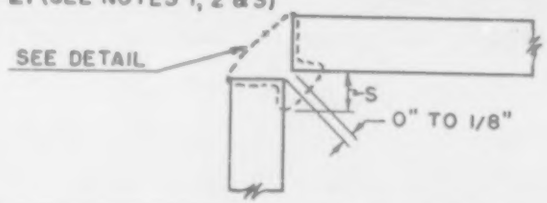
SINGLE-V CORNER JOINT FILLET REINFORCED.

C-12 (SEE NOTES 1, 2 & 3)



DOUBLE FILLET WELDED CORNER JOINT.

C-21 (SEE NOTES 1, 2 & 3)



DESIGN DATA FOR GROOVE CORNER JOINTS

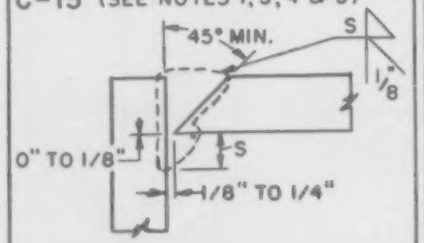
IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

NOTES:

1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 18 INCHES TO THE EDGE OF THE JOINT.
3. S = AS REQUIRED.
4. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
5. WHEN THIS JOINT IS WELDED IN THE FLAT & OVERHEAD POSITIONS OF WELDING NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE JOINT. WHEN WELDED IN OTHER POSITIONS NO OBSTRUCTION SHALL BE CLOSER THAN 18 INCHES.

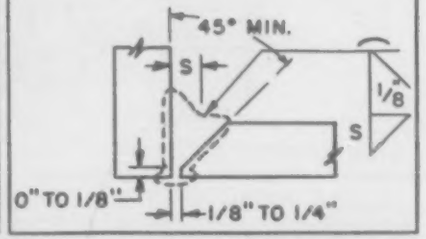
OUTSIDE SINGLE BEVEL CORNER JOINT- FILLET REINFORCED.

C-15 (SEE NOTES 1, 3, 4 & 5)



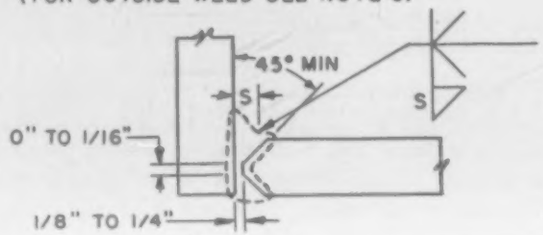
INSIDE SINGLE BEVEL CORNER JOINT-WELDED BOTH SIDES, FILLET REINFORCED.

C-19 (SEE NOTES 1, 2, 3 & 4)



DOUBLE BEVEL CORNER JOINT, FILLET REINFORCED

C-32 (SEE NOTES 1, 3 & 4)
(FOR INSIDE WELD SEE NOTE 2)
(FOR OUTSIDE WELD SEE NOTE 5)



DESIGN DATA FOR GROOVE CORNER JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

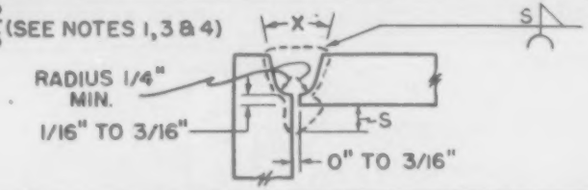
NOTES:

1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. WHEN THIS JOINT IS WELDED IN THE FLAT & OVERHEAD POSITIONS NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE JOINT. WHEN WELDED IN OTHER POSITIONS NO OBSTRUCTION SHALL BE CLOSER THAN 18 INCHES.
3. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
4. S = AS REQUIRED.
5. NO STRUCTURE WHICH OBSTRUCTS THE OPERATORS VISION OF THE ROOT OF THE WELD SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE UNBEVELED PLATE.

JOINT NUMBER	ANGLE X MIN.	POSITIONS OF WELDING USED				ANGLE X REQUIRED ON SYMBOL
		FLAT	VERT.	OVER.	HOR'L	
C-42	45°	√	√	√	√	√
C-49 & C-69	35°	√	√	√	√	
C-45	25°	√	√	√		√
C-66	20°	√	√	√		

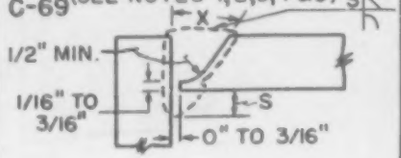
SINGLE-U CORNER JOINT, FILLET REINFORCED

C-42
C-66 (SEE NOTES 1, 3 & 4)



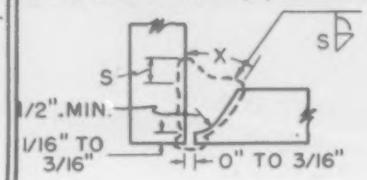
OUTSIDE SINGLE-J CORNER JOINT - FILLET REINFORCED.

C-45
C-69 (SEE NOTES 1, 2, 3, 4 & 5)



INSIDE SINGLE-J CORNER JOINT, WELDED BOTH SIDES, FILLET REINFORCED.

C-49 (SEE NOTES 1, 2, 3 & 4)



DESIGN DATA FOR GROOVE CORNER JOINTS

DESIGN DATA FOR EDGE JOINTS

DESIGN DATA FOR GROOVE CORNER JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

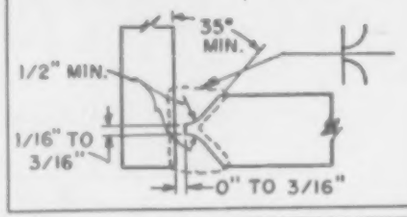
NOTES:

1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
3. NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 18 INCHES TO THE EDGE OF THE JOINT
4. WHEN THIS JOINT IS WELDED IN THE FLAT & OVERHEAD POSITIONS NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE. SHALL BE CLOSER THAN 6 INCHES TO THE EDGE OF THE JOINT. WHEN WELDED IN OTHER POSITIONS NO OBSTRUCTION SHALL BE CLOSER THAN 18 INCHES.
5. S = AS REQUIRED.

DOUBLE J CORNER JOINT

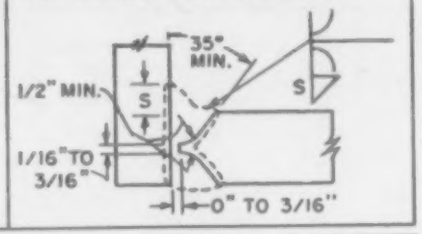
C-61

(SEE NOTES 1 & 2)
(FOR INSIDE WELD SEE NOTE 3)
(FOR OUTSIDE WELD SEE NOTE 4)



C-62 FILLET REINFORCED

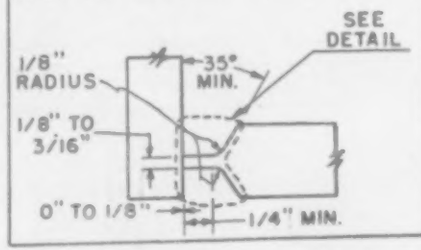
(SEE NOTES 1 & 5)
(FOR INSIDE WELD SEE NOTE 3)
(FOR OUTSIDE WELD SEE NOTE 4)



DOUBLE J CORNER JOINT (MODIFIED)

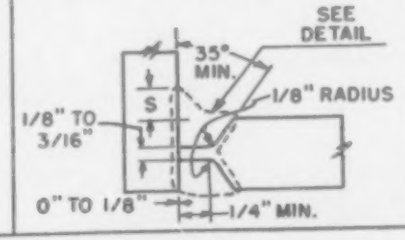
C-63

(SEE NOTES 1 & 2)
(FOR INSIDE WELD SEE NOTE 3)
(FOR OUTSIDE WELD SEE NOTE 4)



C-64 FILLET REINFORCED

(SEE NOTES 1, 2 & 5)
(FOR INSIDE WELD SEE NOTE 3)
(FOR OUTSIDE WELD SEE NOTE 4)



DESIGN DATA FOR EDGE JOINTS

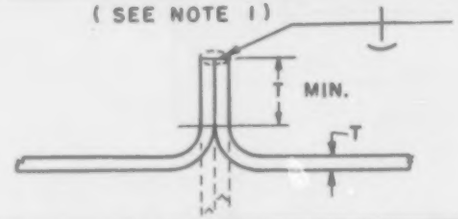
IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

NOTES

1. THIS JOINT SHALL NOT BE USED WHEN ROOT OF WELD IS SUBJECT TO BENDING TENSION.

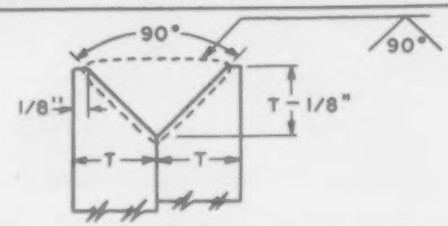
E-1 BEAD EDGE JOINT

(SEE NOTE 1)



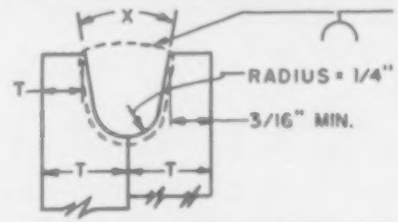
E-11. SINGLE-V EDGE JOINT

(SEE NOTE 1)



JOINT NUMBER	ANGLE X MIN.	POSITIONS OF WELDING USED				ANGLE X REQUIRED ON SYMBOL
		FLAT	VERT	OVER	HOR'L	
E-41	45°	✓	✓	✓	✓	✓
E-42	20°	✓	✓	✓		

JOINT NUMBER	SINGLE-U EDGE JOINTS
E-41 E-42	(SEE NOTE 1)

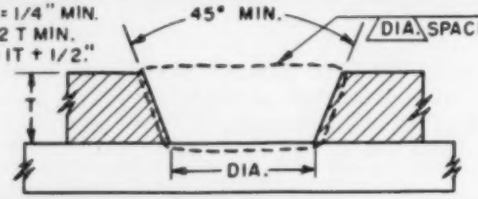


DESIGN DATA FOR LAP JOINTS.

IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.
NOTE.
1. WHEN T IS LESS THAN 1/2", SLOT SHALL BE BEVELED TO A 45° INCLUDED ANGLE.

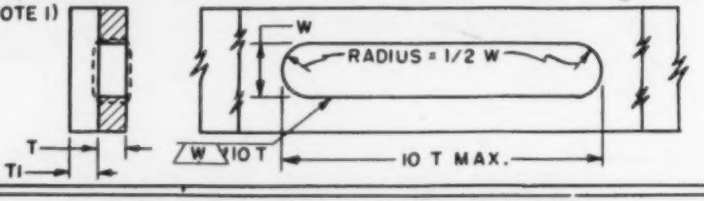
L-11 PLUG WELDED LAP JOINT

WHEN T = 1/8" OR LESS, DIA. = 1/4" MIN.
WHEN T = 1/8" TO 1/2", DIA. = 2 T MIN.
WHEN T = IS OVER 1/2", DIA. = IT + 1/2."



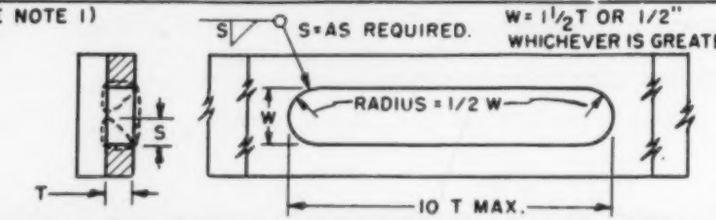
L-12 SLOT WELDED LAP JOINT

WHEN T1 IS LESS THAN T USE JOINT L-14.
WHEN T IS LESS THAN 1/4", W = 2T MIN. WHEN T = 1/4"& OVER, W = 1½ T MIN.
(SEE NOTE 1)



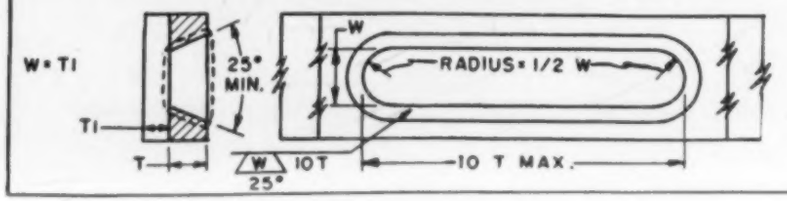
L-13 SLOT LAP JOINT, FILLET WELDED

(SEE NOTE 1)



L-14. BEVELED SLOT WELDED LAP JOINT

(SEE NOTE 1) WHEN T1 IS EQUAL OR GREATER THAN T, USE L-12

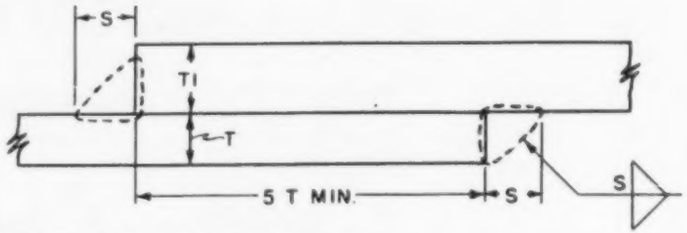


DESIGN DATA FOR LAP JOINTS

IMPORTANT. NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.
NOTES:
1. THIS JOINT SHALL NOT BE USED WHEN THE ROOT OF THE WELD IS SUBJECT TO HIGH STRESSES OR COMPRESSION LOADING.
2. S = AS REQUIRED.

DOUBLE FILLET WELDED LAP JOINT

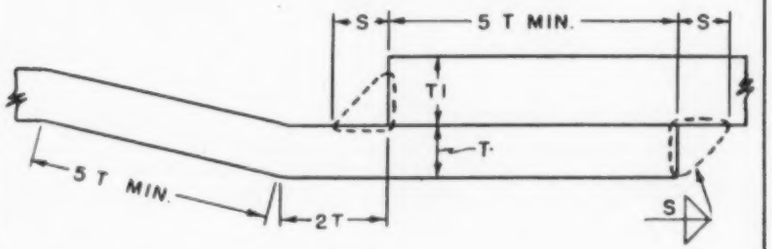
L-1 (SEE NOTES 1 & 2)



THICKNESS OF PLATES MAY VARY.

DOUBLE FILLET WELDED OFFSET LAP JOINT

L-3 (SEE NOTES 1 & 2)



THICKNESS OF PLATES MAY VARY.

DESIGN DATA FOR TEE JOINTS

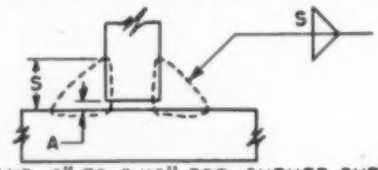
IMPORTANT – NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

NOTES:

1. WHERE "A" IS GREATER THAN 1/16", S = THE SIZE SPECIFIED PLUS A.
2. "L" MIN. = 4 TIMES S, BUT IN NO CASE LESS THAN 1 INCH.
3. "L" MAX. = 16 TIMES THE THICKNESS OF THE THINNER MEMBER, BUT IN NO CASE SHALL THIS MAX. EXCEED 6 INCHES.
4. "C" MAX = 16 TIMES THE THICKNESS OF THE THINNER MEMBER, BUT IN NO CASE SHALL THIS MAX. EXCEED 12 INCHES.
5. "C" MAX. = 32 TIMES THE THICKNESS OF THE THINNER MEMBER, BUT IN NO CASE SHALL THE SPACING BETWEEN ADJACENT INCREMENTS ON OPPOSITE SIDES OF THE MEMBER (SEE DIM. D) EXCEED 12 INCHES.

T-1 DOUBLE FILLET WELDED TEE JOINT

(SEE NOTE 1)

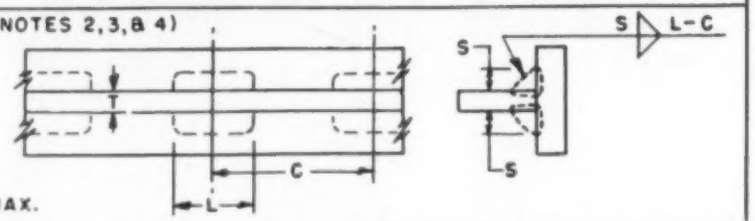


S = AS REQUIRED

A = 0" TO 1/8" FOR STRAIGHT SURFACES AND 0" TO 3/16" FOR CURVED SURFACES.

T-2 CHAIN INTERMITTENT WELDED TEE JOINT

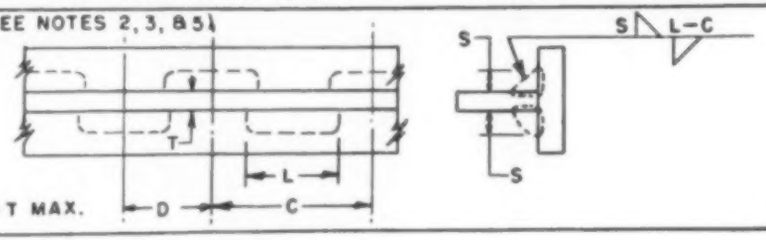
(SEE NOTES 2, 3, & 4)



S = T MAX.

T-3 STAGGERED INTERMITTENT WELDED TEE JOINT

(SEE NOTES 2, 3, & 5)



S = T MAX.

DESIGN DATA FOR GROOVE TEE JOINTS

IMPORTANT NOTES APPLY ONLY TO JOINTS ON WHICH REFERENCED.

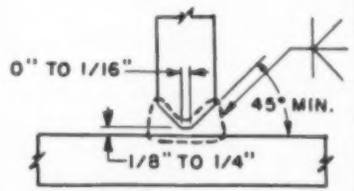
NOTES:

1. REINFORCEMENT OF ALL GROOVE WELDS SHALL BE 1/32" TO 1/8".
2. NO OBSTRUCTION ON THE SURFACE OF THE BEVELED SIDE OF THE PLATE SHALL BE CLOSER THAN 18 INCHES TO THE EDGE OF THE PLATE.
3. CHIP OUT ROOT OF WELD TO SOUND METAL BEFORE WELDING ROOT SIDE.
4. S = AS REQUIRED.

DOUBLE BEVEL TEE JOINT

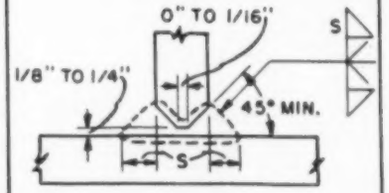
T-31

(SEE NOTES 1, 2 & 3)



T-32 FILLET REINFORCED

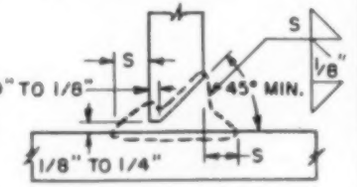
(SEE NOTES 1, 2, 3 & 4)



SINGLE-BEVEL TEE JOINT WELDED BOTH SIDES FILLET REINFORCED

T-14

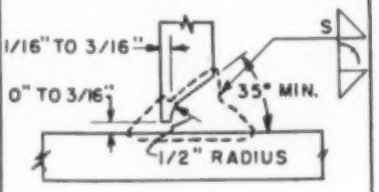
(SEE NOTES 1, 2, 3 & 4)

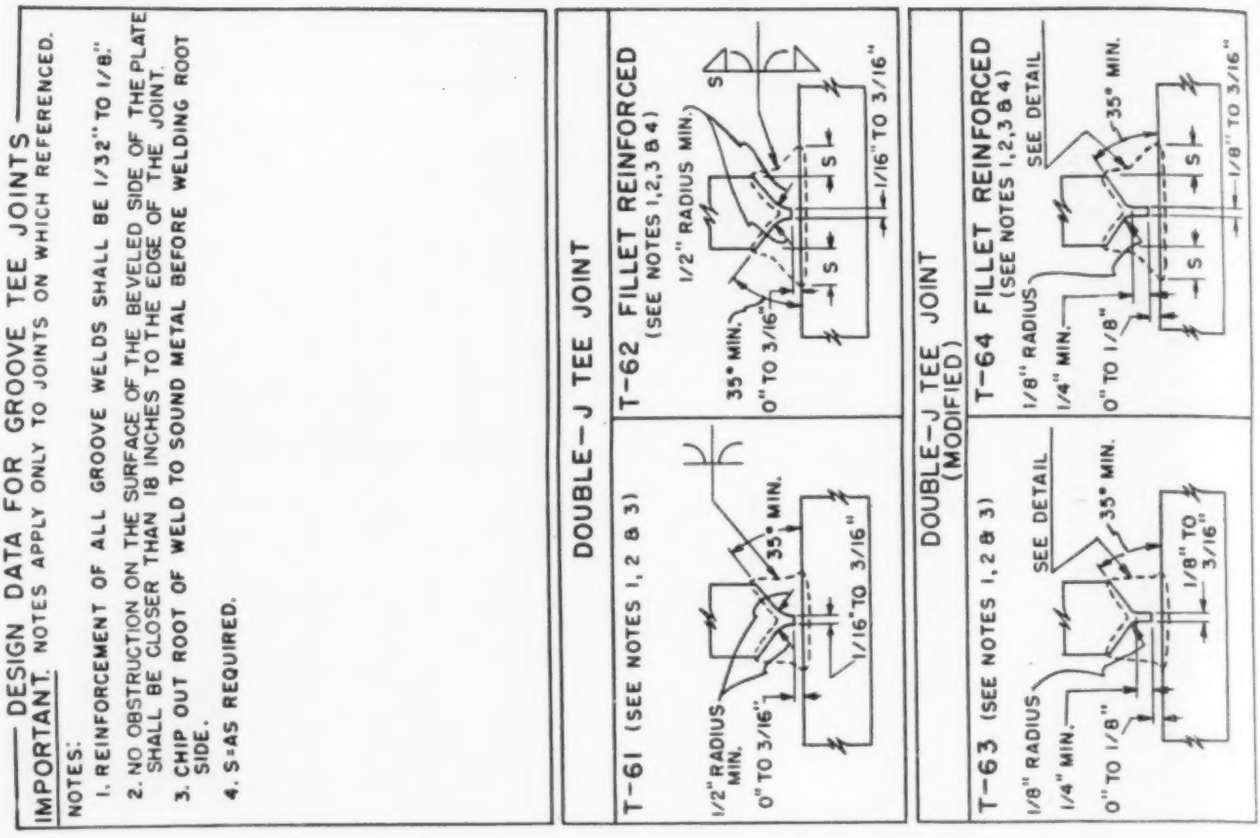


SINGLE-J TEE JOINT WELDED BOTH SIDES FILLET REINFORCED

T-44.

(SEE NOTES 1, 2, 3 & 4)





Statement of the Ownership, Management, Circulation, etc.

REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

OF THE WELDING JOURNAL, published monthly at Easton, Pa., for October 1, 1942.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared William Spraragen, who, having been duly sworn according to law, deposes and says that he is the Editor of THE WELDING JOURNAL and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of — Post Office Address

Publisher, American Welding Society, 33 W. 39th St., New York, N. Y.

Editor, William Spraragen, 33 W. 39th St., New York, N. Y.

Managing Editor, William Spraragen, 33 W. 39th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

American Welding Society, 33 W. 39th St., New York, N. Y.

G. F. Jenks, President, Ordnance Dept., Munitions Bldg., Washington, D. C.

M. M. Kelly, Secretary, 33 W. 39th St., New York, N. Y.

O.B.J. Fraser, Treasurer, 67 Wall St., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

WILLIAM SPRARAGEN, Editor.

Sworn to and subscribed before me this 18th day of September, 1942. (Seal) MARY T. HICKEY

Notary Public, New York County Clerk's No. 154.
New York County Register's No. 4 H 310.
(My commission expires March 30, 1944.)

Preparation for Welding

By H. R. Morrison*

OF PARTICULAR importance in welding is the preparation of the edges to be joined. Such procedure includes the preparation of the edges so as to provide the best possible conditions for welding, the cleaning of the metal edges, and the making of allowances for expansion and contraction caused by heating and cooling.

Principles of Joint Design

In order to avoid possible confusion, it should be pointed out that joint design actually consists of two distinct phases:

1. The design of the cross section of the weld.
2. The design of the manner in which the structural parts come together.

It is beyond the scope of this article to discuss the design of the manner in which structural parts come together and, therefore, it will be confined to the first factor of joint design, the shaping of the edges to be joined and the preparation for welding, touching briefly on expansion and contraction.

Preparation of Edges

Careful preparation of metal edges for welding together sheets, plates and pipe, regardless of the material of which they are made, will greatly assist the operator in making a joining between the two pieces of metal and producing as nearly as possible a single piece of metal with, in effect, no joint at all. This means the beveling of the edges, if necessary, so that the welding operation will penetrate the entire thickness of the base metal as economically as possible. Furthermore, the parts must be located and held, if necessary, so that the distortion will be as little as possible. The simple and fundamental joint designs will be considered now, followed by a discussion of the other factors that must receive attention during preparation for welding. Special joint designs or modifications of these fundamental designs that sometimes are used will be left for consideration in a future article.

* The Linde Air Products Company, New York, N. Y.

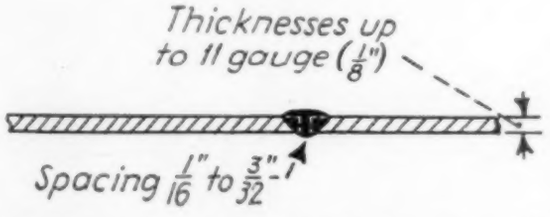


Fig. 1—The Butt-Type Weld Is the Simplest Joint in Sheet Metal

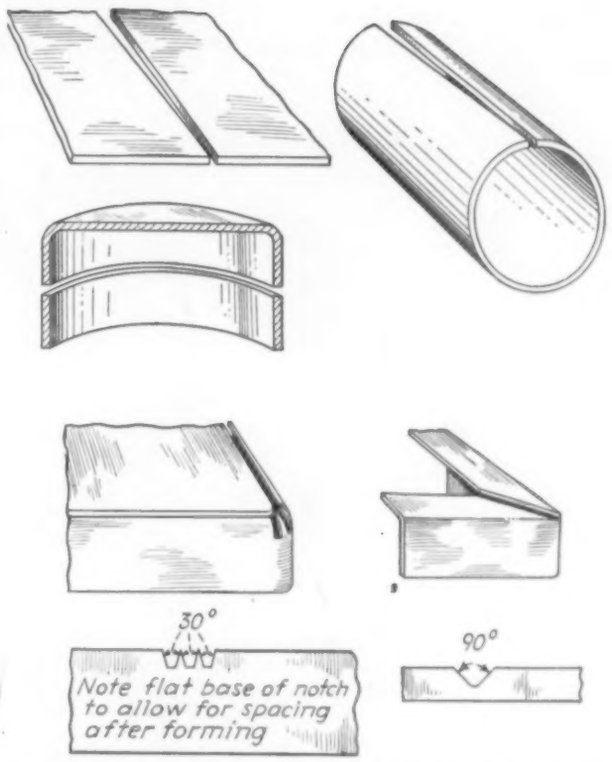


Fig. 2—The Butt Weld Is Used on Structures of This Type

Joints in Sheet Metal

It is the custom in the steel trade to consider all rolled metal up to 1/4 in. thick as sheet metal, while metal thicker than this is called plate.

Butt Weld.—The simplest type of joint in sheet metal is the butt-type weld shown in Fig. 1. With sheet metal it is a relatively easy matter to obtain thorough penetration of the welding operation to the underside of the joint, since the flame will easily melt the entire thickness of the material at the joint at the normal speed of welding. To obtain this thorough penetration, it is desirable to space the parts to be joined slightly so that the flame can reach to the lowest part of the weld. This space between the parts is filled in during welding with metal added in the form of welding rod.

The butt weld is the most frequently used joint design. A number of types of structures on which it is used are shown in Fig. 2.

Flange Weld.—The flange weld, Fig. 3, is also extensively used in sheet-metal work, particularly on sheet lighter than 20 gage (less than approximately 0.04 in. thick). The edges are prepared for welding by turning up a flange, and the weld is then made by melting down this flange, usually without the addition of any welding rod. The upstanding portion of the flange should extend above the surface of the sheet a distance approxi-

mately equal to the thickness of the sheet. It is important that the operator make certain that he is obtaining weld penetration to the bottom of the joint.

Lap Weld.—The lap weld, made along the edge of overlapping sheet, is not recommended for most work. The single lap weld, as shown in Fig. 4, has little resistance to bending and it is consequently quite unsatisfactory for flat sheets. It may occasionally be used, for example, for joining together two cylindrical shells, one fitting inside the other.

The double lap weld, Fig. 5, has better strength characteristics than the single lap, but it requires twice as much welding as does the simpler and more satisfactory butt weld.

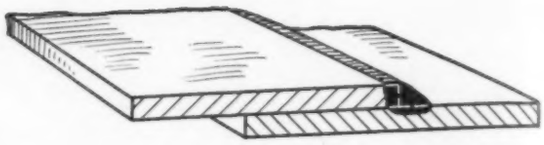


Fig. 4—The Single Lap Weld Is Not Recommended for Most Sheet Metal Work

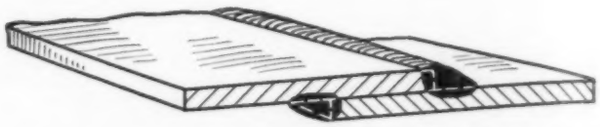


Fig. 5—The Double Lap Weld Has Greater Strength than the Single Lap But It Requires Twice as Much Welding Rod

Joints in Plate Material

The joint designs for plate are fundamentally the same as those for sheet metal, with the added consideration that increased thickness makes a certain amount of special edge preparation necessary to obtain thorough weld penetration.

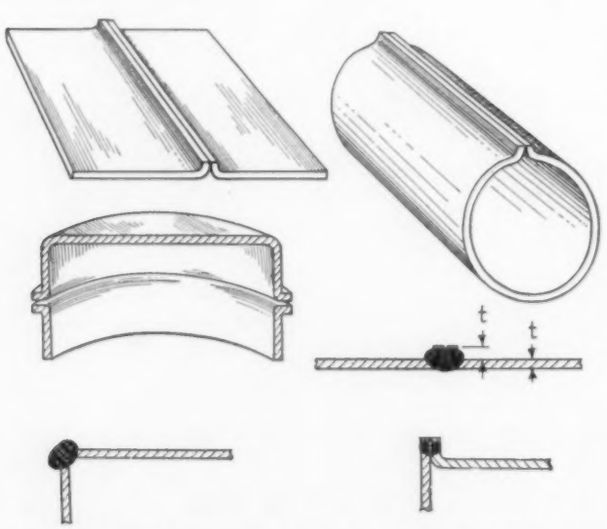


Fig. 3—The Upstanding Portion of a Flange Should Extend Above the Surface of the Sheet a Distance Equal to the Thickness of the Sheet

Open, Square Butt Weld.—For plate $^3/_{16}$ in. or less in thickness the open, square butt weld can be used. This is the same as the butt-type weld for sheet metal with the edges of the plate simply squared accurately. Before welding, however, the edges are spaced about $^1/_8$ in. apart as indicated in Fig. 6, and during welding the operator must be careful to make certain he is obtaining fusion completely through to the underside of the plate.

Open Single-Vee Butt Weld.—For plate over $^3/_{16}$ in. and up to about $^5/_8$ in. thick, the open single-vee butt weld is frequently used. The edges forming the joint are beveled to form an included angle of from 50 to 90°, depending upon the welding technique to be used. While the contour and reinforcement of the completed weld should be about as indicated in Fig. 7, this also depends somewhat upon the welding technique to be used.

Open Double-Vee Butt Weld and Open U-Groove Butt Weld.—Either of two types of edge preparation is recommended for plate more than $^1/_2$ in. thick. Where welding can be performed on both sides of the plate, the open double-vee or double-U groove butt weld, Fig. 8, has certain advantages. For other conditions such as for pipe welding, the open U-groove butt weld has advantages over the single-vee weld in that less welding rod and gases are required. For equipment to be subjected to pressure in service, the codes governing the construction of this equipment should be followed.

Fillet Weld.—The general design of fillet welds is shown in Fig. 9. Fillet welds should be avoided wherever another type of joint can be used, but sometimes the fillet weld is the only type of weld that can be made.

Preparation for Welding

Proper preparation is an important factor in every welding operation. Edges to be joined must be prepared in accordance with the joint design chosen, *and must be clean.* Any necessary arrangements for holding the parts in proper alignment during the welding operation and any preparation for preheating, if this is required, should be made before welding starts, not after.

Preparation of Edges.—For open, square butt welds, the edges are cut so that they will match accurately when assembled for welding. This cutting may be done either by mechanical means or by the oxyacetylene cutting blowpipe. For flange welds in sheet metal, the edges forming the joint are turned up the proper amount.

For open single-vee and double-vee butt welds, the edges should be beveled by whatever economical means will produce the desired results. The oxyacetylene cutting blowpipe can be used to advantage in beveling steel, cast iron, wrought iron and certain alloy steels. Beveling can also be done by chipping, grinding or by machining.

Fig. 6—For Welding Plate Space Must Be Left Between the Edges

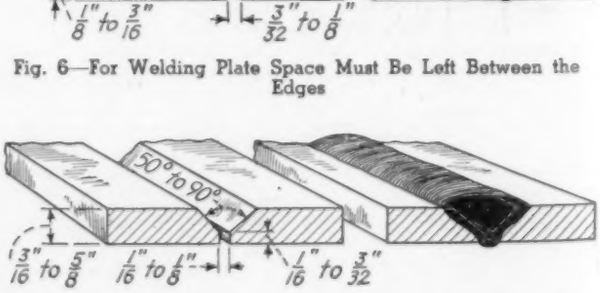


Fig. 7—The Contour and Reinforcement of the Single-Vee Butt Weld Should Be About as Indicated

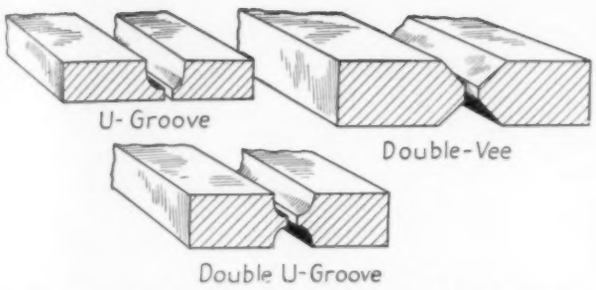


Fig. 8—The Double-Vee or Double U-Groove Weld Is Recommended for Plate More than $^1/_2$ In. Thick

U-grooves are most easily prepared by the use of the oxyacetylene gouging or groove-cutting nozzles.

Cleaning.—Preparation for welding also involves making sure that the edges to be joined are thoroughly cleaned. Oil, grease, paint, rust, scale or foreign matter of any kind must be removed. Where beveling has been done with the oxyacetylene blowpipe, any globules of cutting slag should be knocked off, but it is not necessary to remove the blue-black film of oxide on the cut surface as this does not interfere with welding.

Alignment.—With the edges properly beveled and cleaned for welding, steps should be taken to make certain that the finished job will be in correct alignment. The accuracy of alignment required varies, of course, with the different types of work, being greatest where the parts must line up exactly in the finished job.

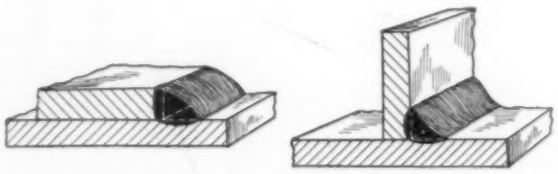


Fig. 9—The Fillet Weld Should Be Avoided Whenever Another Type Joint Can Be Used

Tack welding is often used to hold parts in alignment for welding. Tack welds are short welds placed at intervals along the seam. These welds are either melted out and rewelded during the welding operation or they become a part of the finished weld, depending upon the requirements specified for the weld. Lengths of bar iron, strips of heavy plate or other bulky sections of iron and steel, V-blocks, clamps, jigs and fixtures are all used in various ways for maintaining alignment.

Preheating.—Where preheating is required, the method to be used should be determined in advance and all preparations made so that welding once started, will proceed without interruption.

Undoubtedly preheating with the blowpipe is the simplest form of local preheating. If the part to be welded is small and the ends free to expand and contract, it is necessary for the operator only to play the blowpipe flame over the metal part to be welded before the actual welding is begun.

If a forge fire is available, it provides a convenient means for preheating. Care must be taken, however, that the blower is used only enough to keep the fire going so that too much heat is not applied to the metal. The use of asbestos paper covering is advisable to protect the metal from any possible draft.

Many types of preheating torches are available that burn inexpensive fuels such as kerosene, fuel oil, natural gas or city gas. These can be used to accomplish local preheating on large pieces of metal and, if used in a furnace so that they do not play directly upon the metal, they can be used for general preheating.

The temporary firebrick furnace, fired with charcoal, is the most common preheating agency for general preheating. Charcoal is efficient, inexpensive and procurable almost everywhere. It requires no forced draft to burn and its combustion will give a steady, constant temperature. No soot or smoke is given out that might deposit on the metal and hinder the welding operation. Temporary firebrick furnaces sometimes are fired with gas, oil

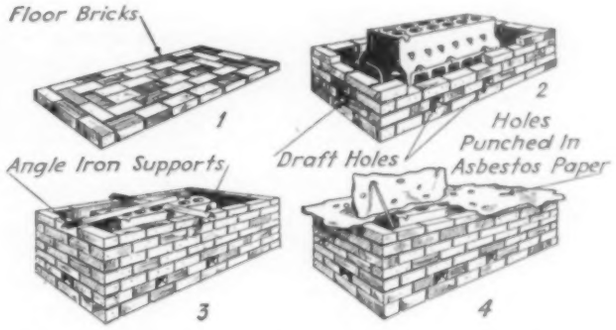


Fig. 10—Ample Provisions Should Be Made for Draft in the Temporary Charcoal Preheating Furnace

or kerosene instead of charcoal. Coke is not a good fuel for this purpose as it gives too high a temperature and too localized a heat.

The temporary brick furnace is constructed by building the brick up around the castings, being certain that enough space is provided around the part for the fuel and to permit handling if turning is necessary during welding. The lower tiers of the brick are set with air spaces between them, as shown in Fig. 10, so that the right amount of air can get into the furnace to insure proper combustion of the fuel. The most useful covering for a temporary brick preheating furnace is a sheet of asbestos paper supported on bars or light angle iron placed across the top of the wall. Several small holes are punched in the paper to allow for the escape of the gases formed by the burning. The section of the metal to be welded should be near the top of the preheating furnace so that when the proper temperature has been reached, the asbestos paper cover can be drawn back sufficiently to allow the welding to be carried on while the part remains in the furnace. After the weld is finished, this cover should be put back over the whole furnace to protect the metal from sudden cooling.

Often permanent preheating furnaces are employed for general preheating where many similar parts are to be welded. Preheating furnaces of this type usually are fired with either natural or city gas. These fuels are selected because the gas flame is easy to control.

Sequence of Operations.—For large or complicated jobs, it is advisable to give careful study to the sequence of operations. This involves consideration of the location of all welds with reference to one another, the probable effect of expansion and contraction, and the method of assuring proper alignment. Such consideration will dictate how any preheating necessary should be done, and the order in which the welds should be made. The time spent in determining such a sequence of operations in advance will be well repaid by the results obtained during the subsequent welding operation.

"Heliarc" Welding*

By T. E. Piper†

CULMINATING research over a two-year period, Northrop Aircraft, Inc., is introducing and giving to the war industries "Heliarc" welding, and trusts that this new method of arc welding will prove a tangible weapon promulgating to some extent the defeat of our enemy. This new method of arc welding has made possible the use of a new material for aircraft construction which lies in inexhaustible quantities off our own shores, and it has simplified methods of construction that will speed plane output. This innovation has been made possible by the courage and perseverance of two men, Mr. V. H. Pavlecka, Chief of Research, and Russ Meredith, Welding Engineer, together with other men of the Northrop organization who believed in them. This new development permits the arc welding of magnesium sheets, extrusions and tubing into structures simpler, lighter and stiffer than is possible in conventional duralumin construction. At the same time, methods of treating magnesium to make it less inflammable and more resistant to heat have been perfected.

The use of magnesium welded structures eliminates the hundreds of thousands of rivets that go into the conventional plane. Rivet heads on the fuselage and wings, even though countersunk, produce resistance to passage through the air, or "parasite drag." At high speeds a substantial portion of the engine power is used to overcome this parasite resistance. In the future, welded magnesium aircraft can be finished just as smoothly as a fine automobile, presenting to the airflow a perfectly uniform and rigid surface.

While magnesium has been used for some time in the aircraft industry for engine parts, wheels and accessories it has never before been used extensively as a primary construction material because of the difficulties in fabricating. The Northrop "Heliarc" welding process makes possible the all-magnesium plane with its many advantages.

Magnesium is the most abundant metal on the earth and in the ocean. Indeed, about 15% of all the dissolved solid matter in the sea consists of magnesium chloride and magnesium sulphate—enough to cover all the land areas of the earth to a depth of 60 or 70 feet or 9,000,000,000 lb. per cubic mile. The mother liquors from the brine of salt wells are always rich both in magnesium salts and bromides. Nearly all the silicate rocks of the earth's crust contain notable quantities of magnesium. Some of these are of commercial importance; examples are talc, soapstone and asbestos, cement and marble. The cost of magnesium alloys at the present time is greater than aluminum alloys. However, because of new magnesium plants under construction and increased production in the plants now in operation, magnesium alloys will be cheaper than aluminum alloys in a very short time. 24,000 kw.-hr. are required to produce a ton of aluminum from Bauxite and only 18,300 kw.-hr. are required to produce a ton of magnesium, which has 54% more volume. Magnesium alloy will shortly be the most plentiful alloy if it is not at the present time. The worlds largest deposits of Brusite, a magnesium bearing ore is in Montana, Washington and British Columbia.

Contrary to popular belief, magnesium alloys are not inflammable when properly processed; in fact they are more resistant to direct flames than aluminum alloys. Although magnesium alloys are 35% lighter than aluminum alloys and 21% of the weight of steel per unit volume, their weight strength ratio is comparable to aluminum alloys, and they possess the design property of stiffness and rigidity that cannot be obtained in other alloys. With these properties of magnesium alloys in mind, together with the rapid production method of attachment and aerodynamic advantages which Heliarc welding presents, the future use of magnesium alloys for the fabrication of structures, especially in aircraft, should be greatly enhanced.

Magnesium castings containing foundry defects have been repaired with this process and welds equal to or stronger than the surrounding metal have been obtained. The weld metal is much more dense than that of the surrounding cast metal and far less susceptible to corrosion. Almost any thickness of cast metal that can be poured may be readily welded with this process.

* Presented at the June 18th Meeting of the Los Angeles Section, A.W.S.
† Process Engineer, Northrop Aircraft, Inc., Hawthorne, Calif.

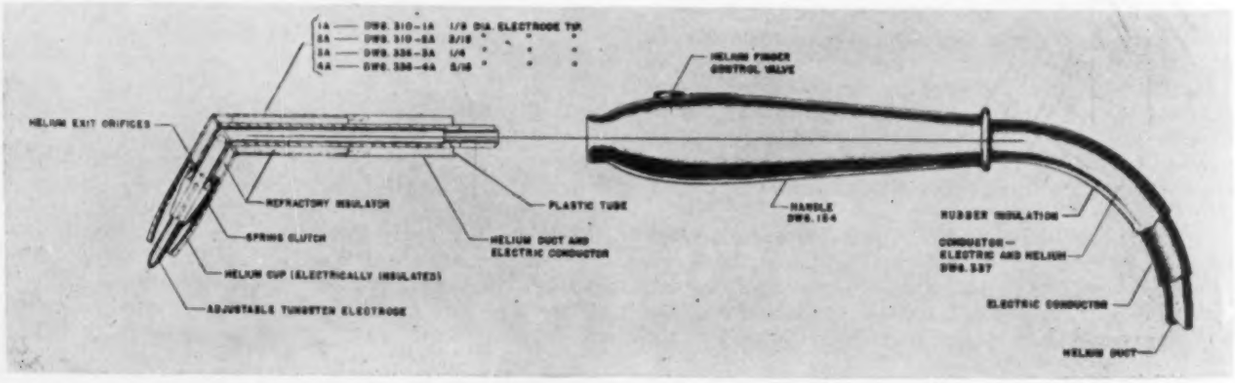


Fig. 1—Helium Arc-Welding Torch as Used for Magnesium Alloys

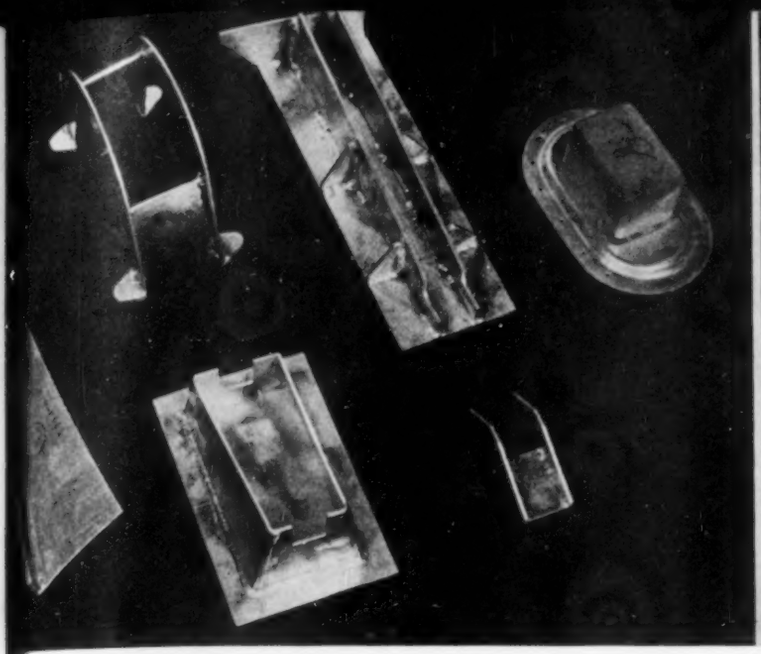


Fig. 2—Photograph of Specimens of Welding

Fig. 3—Photograph of Heliarc Welder at Work

Welding rod of the same alloy as the parent metal is usually used for castings and wrought alloys. The weld ingot appears to have better corrosion-resistant properties than the parent metal in salt spray tests. The weld bead appears to be cathodic to the adjoining metal, which causes minor pitting of the original metal adjacent to the weld under severely corrosive conditions.

The tungsten electrode is very slowly alloyed with the weld metal and naturally in a period of time the tungsten electrode must be replaced. No noticeable increase in the corrosion rate of Heliarc welds in magnesium alloys because of the presence of tungsten has been noticed.

Heliarc weld ingots have in general an extremely fine grain with practically no grain enlargement adjacent to the bead, indicating that there is a minimum of heating effects on the adjacent metal. This accounts for the very good weld efficiencies obtained on Heliarc welded alloys.

Dowmetal J-IH magnesium alloy, Heliarc welded, has approximately 95% of the parent metal strength in the weld area. However, at present the design safety factor for welded downmetal J-IH assemblies is 75% of the strength of the parent metal. These strength values are based on butt-welded joints. Fillet, lap, edge or corner welds are weaker than the butt-welded joint and must be stressed accordingly.

Heliarc welding has proved to be a successful medium of attachment for magnesium, stainless steel, brass, inconel, monel and some of the carbon steel alloys. Research work is now in progress to extend its use to aluminum and other carbon steel alloys not heretofore Heliarc welded. In the Heliarc welding process, a shield of helium gas envelops the molten metal. Because helium gas is an inert gas, it prevents oxidation and eliminates the use of a flux and the danger of entrapped flux in the weld ingot that would promote corrosion. The arc in this process is produced directly between a tungsten electrode and the base metal rather than between two tungsten electrodes as is the practice in atomic hydrogen welding.

The Northrop Heliarc welding torch is equipped with a helium valve that is opened just prior to the striking of the arc between the tungsten and the parent metal which feeds helium through the torch to the weld. Helium has over five times the specific heat of air and when in motion prevents heat accumulation around the weld thereby keeping it cooler and giving a better fusion and penetration with less distortion than other welding processes. The arc is struck by a light brushing action and quickly drawn back from the metal. Northrop Aircraft, Inc., has designed Heliarc torches which will shortly be available to the industry. The torches are of two sizes to handle $^1/_{16}$ to $^1/_8$-in. electrode and $^3/_{16}$ to $^1/_4$-in. electrode, respectively, and may be supplied with tips of different angles 40°, 60° and 90°. The torch may be used for pencil welding or, by extending the handle a handle bar grip is obtained for heavier welding. A type of torch will later be available that feeds the filler rod automatically, giving more uniform results than where the rod is fed by hand. Best results are obtained by feeding the filler rod into the tungsten electrode which melts off portions of the rod thereby casting a uniform weld ingot. This procedure has been found to be superior to the practice of feeding the filler rod into the molten pool under the arc, whereby the molten pool is not sufficiently agitated to break the crust which gathers on the surface of the pool. Since the reflected heat from the tungsten overheats the filler rod, an angle of 60 to 90° must be maintained between the filler rod and the electrode. The tungsten electrode varies in size from $^1/_{16}$ to $^1/_4$ in., depending upon the thickness of metal

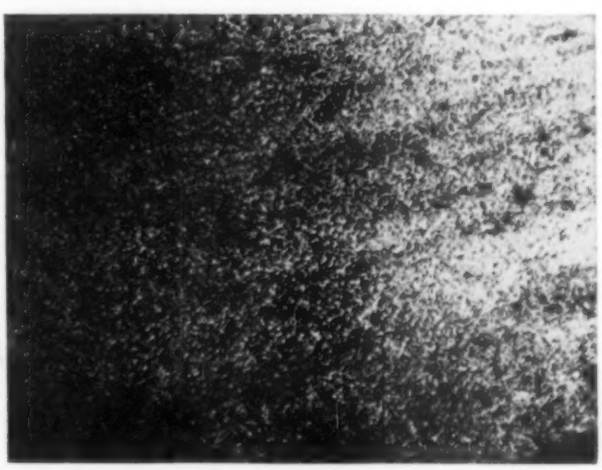


Fig. 4—Microphotograph of Grain Structure of Weld. × 500
Acetic acid etch showing weld fusion or blending characteristics of weld ingot with parent metal. Weld ingot (darker half of print) made of Dowmetal J alloy rod blended with Dowmetal J parent metal (lighter half of print).

welded and the heat required. The torch must be held as near the weld as possible to obtain maximum benefit from helium for the prevention of oxidation. Also an arc length of 0.060 in. maximum should be maintained. Poor penetration or gas holes may result by using too long an arc. On those alloys that have a tendency to be hot short, a rapid welding speed is recommended, approximately three feet per minute, to eliminate the danger of cracking.

A conventional arc welding machine with direct current generator having a 150-amp. output is desirable. However, higher output machines which operate at less than 300 amp. may be used providing lower amperes may be obtained. An upright machine is preferable in that it is easier to attach a helium tank to such a unit. Separate amperage and voltage regulators must be provided and the machines should have a continuous sequence of five increments of current control. The average life of a 200 cu. ft. helium tank is about 35 hr. of continuous welding with a medium-sized torch. Fairly pure helium gas is required. Normally helium as purchased from the Government plant is sufficiently pure to cause no difficulty. Additional gases in helium such as carbon dioxide, hydrogen, nitrogen and the hydrocarbons may cause pronounced defects. Hydrogen produces bad porosity. Oxygen films the metal causing poor coalescence and inclusions. The presence of 7% nitrogen in the helium reduces the welding speed to about two-thirds that obtained when only 2% is present. All of these gases if present, may be removed, however, by passing the helium through filtering mediums.

This method of arc welding has provided an important new tool for the fabrication of structures from alloys such as magnesium and stainless steel. Any type of joint which has been commonly used for welding ferrous metals, may be employed on magnesium and stainless steel.

Stainless steel has heretofore been the most difficult alloy to weld and could only be satisfactorily arc welded by the use of atomic hydrogen, and then only on thicker sections. By the Heliarc welding process, thicknesses of less than 0.010 in. may be very easily welded. In the Heliarc welding of stabilized stainless steel the extent of carbide precipitation is very low as compared to other methods of welding, which greatly increases its fatigue factor. The medical profession would do well to consider this process for the arc welding of stainless steel braces in bone surgery where spotwelding and other means of attachment have not been so successful.

In the Heliarc welding of magnesium structures a tungsten electrode is used with reversed polarity making the magnesium the anode. For ferrous and copper alloys, a carbon electrode is used and the welded structure is the cathode. Craters are eliminated in reverse polarity welding.

For the high temperature melting and heat resisting alloys Heliarc welding has proved successful where other welding methods failed. Heliarc welding gives the greatest penetration of any known welding process.

The Dow Chemical Co. has worked on this process in a parallel vein, and at the annual meeting of the AMERICAN WELDING SOCIETY in October they presented* the metallurgical aspects of Heliarc welding.

* This article will be published in the December issue of THE WELDING JOURNAL.

Safeguards for Arc-Welding Operators in War Production

By W. E. Wilson*

DISCOMFORTING as the thought may be, life involves the possibility of accidental death every day. The fact that fatal accidents happen to people at work and at play, as well as en route from place to place, is reflected in almost every daily newspaper. Usually, it is easy to imagine how a little care or forethought might have prevented the occurrence of many accidents.

An occupation of any kind may involve hazards which carelessness or lack of forethought or lack of understanding may turn into accidental death for one or more workmen. In general, a workman of considerable experience in a particular occupation is better able to avoid the hazards of that occupation than a workman of less experience. Likewise, whether one occupation is more or less hazardous than another is a question for which the record of practical experience provides about the only basis for a reliable answer.

During the past ten years or so, arc welding has grown to be an important industrial process, furnishing an occupation to hundreds of thousands of workmen. Demands of production for the war effort have more than doubled the use of arc welding in the past two years. Thousands of young men all over the nation have been and are being trained in the application of this process. What hazards are involved in this occupation? How can these hazards be avoided?

* Industrial Dept., General Electric Co.

Correct answers to both these questions are deserving of a clear understanding and careful attention by everyone having to do with arc welding. Veteran operators undoubtedly have learned some of the answers to these questions from experience. It is doubtful, however, whether anyone knows all the answers, and certainly everyone engaged in the industry does not. In the absence of facts, rumors have circulated throughout the industry from time to time, causing some misinformation to exist in the minds of many people. Obviously, a man cannot do his best work if his mind is haunted by fears and misunderstandings of the unknown. Neither can he continue to live happily or produce much if carelessness or lack of information results in unwarranted hazards to his person.

Efforts have recently been made, therefore, to assemble all known facts regarding the extent of any occupational hazards connected with arc welding in order that everyone in the industry might be better informed regarding ways and means to avoid whatever hazards may exist. It is believed that these facts should contribute much to the peace of mind which comes with better understanding and should materially improve output for the war effort.

In searching for such facts, information was gathered from three available sources.

1. Records of insurance companies.

2. Available case histories of accidents to welding operators.
3. A sample survey among users of arc welding.

In general, it was found that insurance companies do not keep records of arc welding operators segregated from records of other men who work with electricity. Available records in which welding operators are included, however, indicate that as an occupation arc welding is relatively safe.

For instance, with the exception of one other occupational hazard (drowning), electric shock has been reported as the *least* frequent cause of industrial fatality among a group of insurance policy holders which included electricians, arc-welding operators, men working in power plants and others frequently or occasionally handling electric equipment.

Records of another insurance company for the year 1939 show that, of all occupational deaths caused by electric current, only 1.15% occurred to welding operators, or only one in 87 deaths.

Some additional light is thrown on the subject by the records of another insurance company. Although gas welding normally is not considered especially hazardous, arc welding is one-fourth less hazardous as measured by their records of the necessary compensation rates for accident cases.

The fact that such records indicate fatalities from electric shock to be relatively low speaks well for safety precautions exercised against this particular hazard by industry as a whole. These precautions by all means should be continued and improved wherever possible.

How Fatalities Occasionally Happen

A review of available records covering deaths which have occurred to arc-welding operators while at work reveals that complete facts regarding fatal accidents are seldom known because the event of such a death has seldom been witnessed. For this reason, causes usually must be deduced from any known or presumed circumstances preceding the event, as well as from observed circumstances after the event has been discovered.

Some little time is usually required to assemble known facts, make examinations and arrive at a reasonable conclusion regarding causes. The public is always impatient for news, however, and newspapers, in their haste to produce this commodity in a dramatic way, have not always waited to get accurate facts. As a result, misleading reports have been publicized and many people have obtained confused, exaggerated and entirely erroneous ideas with regard to causes of fatalities.

For instance, on one occasion, a welding operator was found dead inside a metal structure which happened to be so shaped that, to be comfortable, he had to work in a sitting position. Very little natural light was present; hence, he employed a portable electric lamp with wire guard. When found, he was in a sitting position, apparently comfortable and relaxed, with his welding glove in his lap and the bulb of his portable lamp broken, exposing the two "live" filament supports. A new lamp bulb also was in his lap. Across his lap lay the welding cable with the electrode holder hanging a few inches above the metal plate on which he was sitting.

Immediately, newspapers published the accident in terms which led readers to believe the welding circuit had caused the death. Careful observation and analysis of the circumstances by authorities, however, led to the more probable conclusion that his fingers came in contact with the exposed filament supports of the broken lamp as he attempted to remove it in the dark to put in a new bulb.

WORKER IS KILLED IN FREAK ACCIDENT

A freak accident in the shops, yesterday took the life of Jr.,

Investigators said stumbled and fell in such a manner that the electrode on his welding instrument was jammed in his mouth. The charged connection sent 550 volts through the workmen's body, killing him instantly.

Welder Electrocuted In Shop

An electric welder's protective clothing was blamed for his electrocution yesterday in the at the first fatality in the plant's electric shops in more than a year.

As his two brothers, fellow-workers, watched, Jr., 32, of Ave., fell dead after 440 volts passed through his body.

Workers said heavy clothing, which all workers in the shop are required to wear for safety, was soaked with perspiration and, as he accidentally touched a highly charged arc rod used by another worker, a short circuit was caused and the power passed through s body.

Fig. 1.
Oftentimes newspaper accounts of accidents are inaccurate because all facts are not available, as evidenced by these two clippings from different newspapers on the same accident.

Fig. 2—Extra Safety Precautions Should Be Exercised When Arc Welding Heavy Work Especially in Hot Weather

For the sake of news, therefore, it is quite probable that this was just another case where an arc-welding circuit was charged with a fatality which might happen to anyone in almost any occupation. While undeserved publicity of an adverse nature seldom does anyone any good, misleading publicity can do real harm to readers who fail to realize the true causes of trouble.

For instance, in a neighboring city and shortly after the above accident, a boiler maker was found dead inside a boiler under very similar circumstances, except that there was no welding circuit on the job. Who knows but what the very absence of that which had been publicized as being the source of danger might have contributed to a false sense of security which in turn made this particular boiler maker careless of other real hazards which were present?

The tendency to attribute a fatality to electrocution with utter disregard for facts is shown by two news clippings (Fig. 1) taken from two newspapers of the

same date, and each purporting to describe the same fetal accident to a welding operator. The first clipping raports, ". . . stumbled and fell in such a manner that the electrode on his welding instrument was jammed in his mouth. The charged connection sent 550 volts through the workman's body." The other says, ". . . 440 volts passed through his body . . . as he accidentally touched a highly charged arc rod used by another worker."

Obviously, both reports cannot reflect true causes and in all probability, neither does. It is a known fact, for instance, that measurement of voltage at the electrode holder immediately after the accident showed a maximum of 76 volts—not 550 or 440 volts.

When a man's body, gloves and clothing are dry, 76 volts can be handled quite safely, as illustrated by hundreds of thousands of welding operators who handle such voltages every day without ill effects. However, it is well known that when the human body is wet from perspiration, contact with an electric circuit is likely to be much more hazardous than when the body is dry. Therefore, if electrocution is to be accepted as the true cause of this fatality, it must be recognized that when an operator's clothing and gloves are soaked with perspiration, he should be especially careful to avoid making contact with any electric circuit.

The hazard is quite the same as that involved when a person touches an electric fixture such as a lamp socket or heater while standing in a tub of water. Such electric appliances are ordinarily safe to operate while a person is dressed in dry clothes. But occasionally we read of someone being electrocuted by switching a lamp on or off while standing in the bath.

There is no mystery about such cases. Moisture simply lowers the electrical resistance of a person's body to such an extent that the relatively low voltage of even a lighting circuit or welding circuit may send enough current through the heart to cause death. The one and only safe way to use any electrical circuit, whether it is a lighting circuit, welding circuit or what not, is to treat it with respect at all times and to be especially careful when the body and clothing are wet with perspiration or other moisture.

Safety of A.-C. Versus D.-C. Welding

Compared to the use of direct current (d. c.) the use of alternating current (a. c.) for the welding circuit is relatively new, having grown to its present state of use almost entirely during the last 4 or 5 yrs. As is usually the case with anything new, its adoption has met resistance, some of which has been due to the question of whether or not it is more or less hazardous than d.-c. welding.

Unfortunately, a few fatalities have occurred on jobs where operators were using a. c. as well as they have occurred on jobs where operators were using d. c. In the case of the former, however, rumors regarding such accidents have had unusually active and wide circulation (probably because of the relative newness of the process), which undoubtedly has resulted in an exaggerated idea of the number of such cases, particularly among operators familiar only with d.-c. welding.

To consider any question of whether a.-c. arc welding is more or less hazardous than d.-c. arc welding, however, borders a little on the ridiculous because this question is somewhat like considering whether or not it is safer to go boating on Lake Erie in a white boat or a red boat. If you're careful to observe all ordinary marine precautions, one boat is as safe as the other. On the other hand, if the peacefulness of surroundings or interest in fishing lets you drift out into the Niagara River and onto the rapids above the Falls, it makes very little difference which kind of boat you started out in.

Nevertheless, this question is likely to persist in the minds of many people for some time to come, and for that reason a sample survey was recently made to see if any reasonable answer to this question could be obtained from experience. Five different companies employing a large number of welding operators using both a.-c. and d.-c. arc-welding equipments under similar conditions were canvassed for the year 1941. The information so obtained is shown in the following tabulation:

Company	Welding Operators			Other Factory Employees		Total No. of Employees per Fatality
	Total No. Using:		Operator Fatalities	Total	Fatalities	
	A.C.	D.C.				
1	30	270	0	4,700	10	500
2	120	5	0	475	0	(Infinite)
3	160	240	1	6,600	2	2,333
4	270	30	0	2,700	1	3,000
5	800	730	0	82,000	4	20,850
Grand Total	1380	1275	1	96,475	17	5,500

From these records, it appears that company No. 1 was engaged in operations involving relatively high industrial hazards. Operators of d.-c. arc welders predominate but no fatalities occurred to any welding operator.

Company No. 2 operated the entire year without a single fatality to any workman, indicating either that no serious hazards were involved or that safety measures were carefully observed.

Company No. 3 had three accidental deaths occurring among a total of 7000 workmen, indicating its operation to be more hazardous than any other of the companies except No. 1. One of these deaths happened to occur to an operator of a.-c. welding equipment with the probable result that most employees of this particular plant feel that a.-c. arc welding is much more hazardous than d.-c. From a broader viewpoint, however, it seems doubtful that this feeling is justified and indeed, if it does exist, it would be an actual liability if it were to make them relax constant care when welding with direct current.

Company No. 4 operated with a large predominance of a.-c. operators, but no fatal accident occurred to any of them.

Company No. 5 throws additional light on the subject because of its comparatively large number of welding operators. If the experience of operators in company No. 3 were any indication of a.-c. welding hazards, it would be expected that company No. 5 with 5 times as many a.-c. welding operators would have had five times as many fatalities among such employees. As a matter of record, they had none.

It is recognized that out of the estimated 200,000 or 300,000 arc-welding operators in the U. S., the above survey covers only 2655 for a period of 1 yr. In looking over these figures, it is obvious that a much more extensive survey would have to be made, covering perhaps a representative 50% of the entire industry and for a longer period of time, before any reliable conclusions could be drawn regarding the relative hazards of a. c. compared to d. c. as reflected by actual practice.

However, the companies included in this sample survey were fairly representative of those which used both a.-c. and d.-c. manually operated arc welders for general

fabrication of machinery during the year 1941. About the only reasonable conclusion which can be drawn from this particular record is that any hazards which may be connected with arc welding appear to have caused no more fatalities than hazards of other work done by the same companies. Furthermore, arc welding appears to have been safer in most of these cases.

Recognizing Hazards

In addition to records assembled in this sample survey, a review of available case histories of individual fatalities which have happened to welding operators in the past years indicates that either one or both of two conditions were almost always present:

First, almost without exception, the fatality occurred in the hot summer months when the operators' clothing and gloves were soaked with perspiration. This definitely indicates the need for extra precaution under such conditions which are likely to be present not only in the hot weather, but also when welding is done at high speed on heavy work. Since a.-c. arc welders have made it possible to use higher welding currents and to obtain faster production speeds more successfully than have d.-c. arc welders, the former are used on the large majority of such applications today.

Therefore, it is not especially significant that a.-c. arc welders may have been present in a majority of the relatively few cases when accidental death has occurred under such conditions. *The important thing which should be realized* by all who have to do with arc welding is that it is *not the type of arc welder* which influences the hazards so much as it is the *conditions under which the work is done* and the *care exercised by the workmen doing it.*

The second condition which has almost always been present whenever a fatality has occurred is that other factors which might cause or contribute to death have also been present. These other factors include poor physical condition, extreme heat, poor ventilation and falls from elevated locations.

For instance, in one case a welding operator was found face down on a metal floor where he had fallen from an elevated platform. His electrode holder was under his body. The day was especially hot and humid. He had complained of the heat only a short time before the accident. The autopsy held by the coroner's physician failed to single out any particular injury as the cause of his death and the conclusion drawn, therefore, was that death was caused by electric shock. However, the real cause or causes of his death, whether it was electric shock, heat fatigue, the fall from an elevated platform or a combination of these or other unknown conditions at the time of the accident may never be known.

Thus, if hazards are to be reduced, it is vitally important for everyone to recognize and avoid all hazardous conditions while working at any job, including welding. When and if other factors are the real cause of death, it only increases their danger to hastily attribute an otherwise unexplainable fatality to electrocution, simply because live conductors are in the vicinity as they always are with arc welding.

In view of these observations, therefore, it seems reasonable to conclude that neither a.-c. arc welding nor d.-c. arc welding involves any mysterious or unavoidable hazards and that impressions to the contrary can be attributed largely to rumors, some inspired, and some having arrived through natural reticence on the part of officials to publish details of unfortunate accidents.

This conclusion, however, should not make any one feel relieved of the responsibility of seeing that adequate safety precautions are observed in arc welding, as well as in any other industrial operation. With the extra toil and sweat which arc welding operators everywhere are putting into the war effort these days, extra precautions against chance contact with *any electric circuit* are essential if the possibility of harmful electric shock is to be avoided.

The reference to "any electric circuit" is particularly emphasized because the welding operator not only handles the welding circuit, but he also may handle portable lights, portable motor-driven tools, and in some instances he may even handle switches or portable cable on the power-input side of the arc welder.

Unless the insulation of all such devices, and of the cables running to them, is maintained in good order, chance contact with an electric circuit is difficult to avoid. Should the operator contact an electric circuit with sweat-soaked gloves or shoes or other parts of his clothing or body, the chances of harmful or even fatal electric shock are much greater than if his body were dry. Therefore, equipment must not only be kept in good repair electrically, but welding operators must be extra careful to avoid contact with the welding circuit or any other electric circuit, especially during hot weather and when welding with high current or heavy work.

Avoiding Hazards

Personal safety in arc welding not only requires reasonable care on the part of operators but it also requires proper safety equipment.

For example, fully insulated electrode holders should always be used unless there is some good reason to the contrary. Not only do they reduce the hazard of circuit contact for the welding operator, but they practically eliminate the possibility of accidental contact with other workers while the electrode holder is lying idle or being carried.

Welding operators should exercise special care when they are working alone, when water or perspiration is present, when ventilation is restricted and when the location of their work is above the floor or ground level.

Many of the safety precautions which are called for are obvious. They include the use of adequate ventilation, sturdy scaffolding, preferably of wood, careful maintenance of cables and other accessories, the use of clothing in fit condition and the provision of insulating mats of wood, cork or wool.

In cases where insulation of the operator from the work or from the welding circuit is not feasible for practical considerations, or where there is any likelihood of an otherwise harmless shock causing or contributing to a fall or other accident, a means of disconnecting or reducing the voltage may be employed to prevent full open-circuit voltage from remaining on the electrode or holder when the arc is not in use. A.-c. arc-welding equipment lends itself particularly well to this type of control. However, since there has been very little or no demand for such control devices, they must be regarded as special equipment for unusual circumstances rather than as standard control device for general use on arc-welding equipment.

The attention of safety engineers and supervisors should be directed mainly toward the strict observation of safe practices with particular attention not only to the hazards of electric shock, but to all other hazards which may be and usually are present to a greater or lesser degree, especially with high-speed production in hot weather.

Distortion and Shrinkage Problems in Ships and Other Large Structures*

Part II—Methods of Correcting Distortion

By LaMotte Grover†

NOTE: *Part I of this article, which appeared in the October 1942 issue of the* JOURNAL, *is a discussion of the control of welding and other production operations to prevent distortion. The article is concluded in this issue, with a discussion of flame straightening, cold straightening and hot straightening with force, for removing distortion.*

Cold Straightening and Hot Straightening with Force

WHEN welded parts are small enough to be handled to straightening rolls or presses, it is often cheaper to eliminate jigging or clamping to prevent distortion and to straighten the parts cold after welding. Pipe tunnel frames like the one shown in Fig. 7 of Part I can be straightened in a press or roll much more quickly than by flame straightening or hot peening as used in some shops.

Sharply kinked edges of plating can be straightened easily with a rail bender without heat.

It is important to differentiate between hot straightening, accomplished largely by the use of jacks, maul and flatter, etc., and flame straightening without the aid of force, which will be discussed later. When buckling is mostly of an elastic nature and the plating is largely just sprung out rather than sharply knuckled or kinked, fairing can be done more easily and very rapidly by flame straightening. For sharp kinks or knuckles, strong backs are used along with a maul and flatter, or perhaps a jack or bolts welded to the plating and extending up between strong backs installed on the concave side of the buckle (Fig. 18). When force is used in this way the operation is essentially hot working or forging and the metal is heated to a higher temperature than for flame straightening.

When a strain is put on a buckle prior to heating, the plate should not be sprung too near to a fair condition, or it will just warp out in the opposite direction upon the application of heat.

To correct serious angular distortion at butt welds it is necessary to strong back across them and use a maul and flatter.

Although the physical action is principally the same in this hot straightening as in flame straightening, and is essentially an upsetting of hot metal to shorten it, the stiffening afforded by strong backs and the applied external force make it unnecessary to rely upon the comparatively small stiffness of the plating alone to furnish the reactions causing the upsetting. Therefore, more heat and higher temperatures can be used and the heat is often applied at different locations with reference to the distortion. Large spot heats or heats directly on the kink, as at butt welds, can be used when the straightening is accomplished mostly by force.

Since flame straightening (without the aid of force or temporary stiffeners) depends upon restraint or stiffness that is inherent in the structure itself, it is difficult to flame straighten some assemblies such as small bulkhead sections before they are tied into other parts of the ship. When proper support and dogging of plate edges is not provided during welding, free edges often kink badly, as explained previously, especially when stiffener welds stop short of the plate edges; and these kinks or buckles must be removed by hot straightening with a maul and flatter.

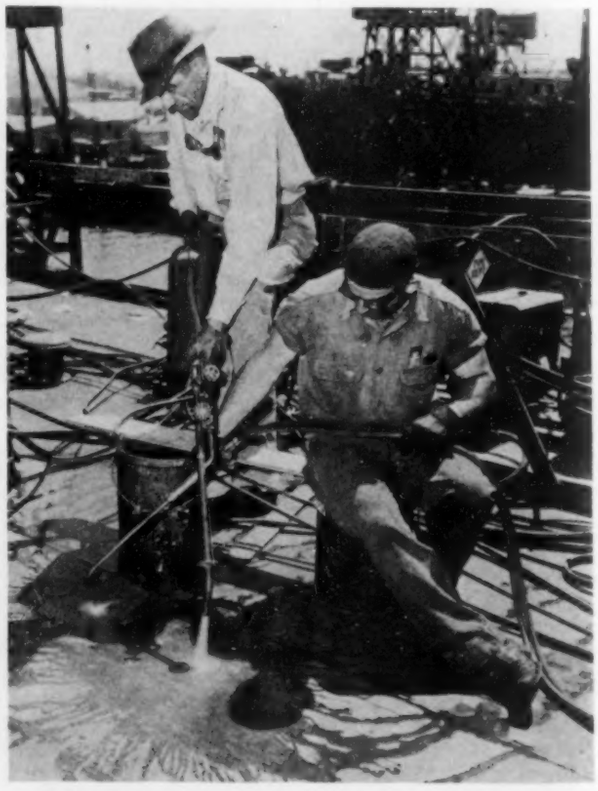


Fig. 15—Making One Spot Heat on Superstructure Deck While Quenching Another Spot Previously Heated

* Presented at the Annual Meeting, A.W.S., Cleveland, Ohio, Oct. 12 to 15, 1942.

† Structural Welding Engineer, Air Reduction Sales Co., New York, N. Y.

A heavy plate or slab, slipped under the plate edge and supported from it by hooks (if a straightening slab is not available) provides a good foundation for this work. Wedge-shaped areas at the kinks are brought up to a bright red heat. After part of the slack has been whipped out by working from the periphery of the buckle in toward its center, the rest will be removed by shrinkage, as in flame straightening, the action being facilitated by quenching with a spray.

Fundamental Principles of Flame Straightening

The same physical phenomena are involved in flame straightening as those which enter into the occurrence of shrinkage stresses in welding, which are thoroughly explained on pp. 233 to 239 of *Welding Metallurgy* by Henry and Claussen, published by the AMERICAN WELDING SOCIETY in 1940. Flame straightening is essentially no more than the application of heat to a localized area of metal in such a way that the resulting expansion is hindered by surrounding colder rigid metal, thus causing the hot metal to become upset or shortened, but also thickened slightly, with no change in volume. Upon cooling, the metal contracts in at least one direction, to a length less than its original length. Since a highly localized, quickly applied, heat is required, the oxyacetylene flame is used universally in this process.

Rapid cooling, as afforded by quenching the heated areas with a spray of water or of air and water, speeds up the process, and also accomplishes more upsetting, because local quenching prevents the upset metal from remaining plastic long enough to stretch while the surrounding area is cooling. However, name straightening is done frequently without an accompanying quench.

This upsetting or shrinkage in length takes out slack which causes buckles in plating. When a series of heats, or a progressive localized heat, is applied along one edge of a bar or structural section, that edge, upon cooling, becomes shorter than the opposite edge and the curvature of the piece may thus be changed.

Since the increase in thickness during upsetting is practically indiscernible, some users of this process have assumed that applying a quench after heating results in a reduction from the original volume before heating. The writer has not been able to find any basis for such an assumption among the data on physical and metallurgical changes in steel during heating and cooling, which have been very thoroughly explored for ordinary carbon steel as used in shipbuilding.

The theory of shrinkage by upsetting seems adequate to explain behavior in all cases except where there may be some local stress relief involved also, as a result of quickly applied heat at not too high a temperature. The possibility of such action has been mentioned previously in connection with the welding of chafing bars opposite face plate-to-web welds of hatch side girders.

Such a local stress relief may enter into the action when decks or bulkheads are faired by heating lines or rows of spots (Fig. 16) directly opposite the welds joining stiffeners or deck beams to plating. The usual upsetting action of flame straightening would be expected to make stiffeners or beams bow outward when heat is applied to the plating directly opposite the connecting welds, and indeed it does this sometimes, especially when too high flame straightening temperatures are used

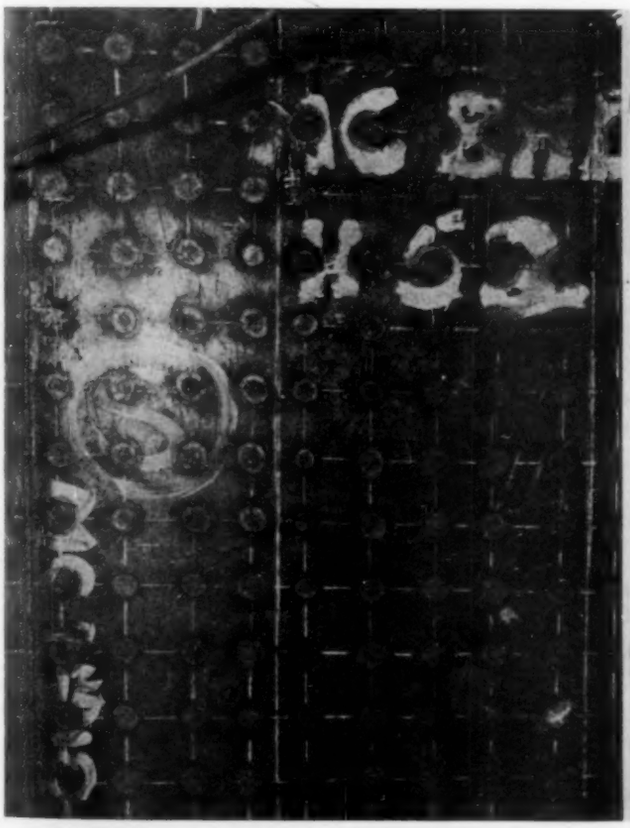


Fig. 16—Staggered Spot Heats, Opposite Stiffener Welds of Superstructure Bulkhead

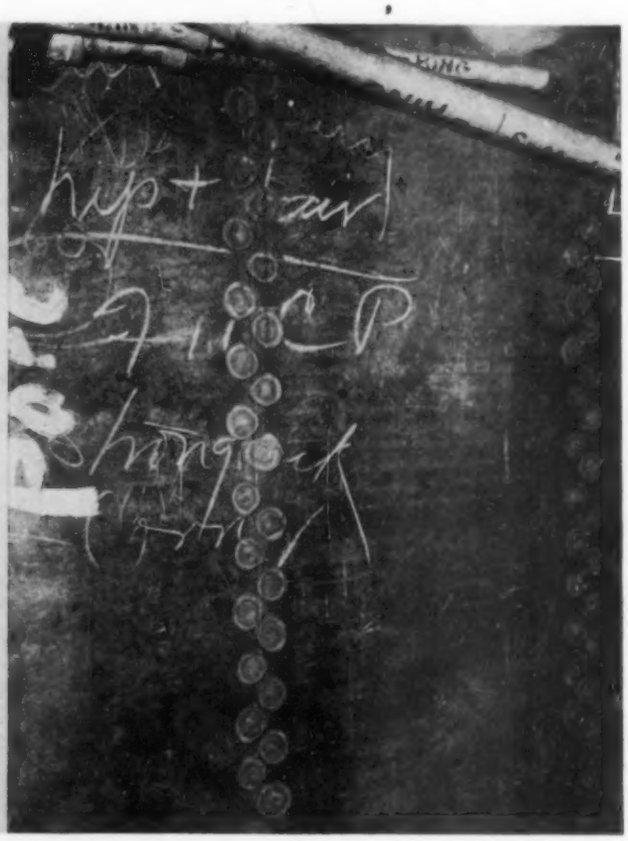


Fig. 17—When Buckling Is Very Severe, More Spot Heats Are Made, Working in from Stiffeners Toward Center of Buckle. If Temperatures and Size of Spots Are Held Down, It Is Seldom Necessary to Cover an Area Completely, as Shown

or when the heat is spread or weaved too widely. Then a subsequent heating of the heels of the beams or stiffeners is necessary to draw them back. The welding itself will often cause stiffeners or beams to sag. Before starting the fairing of a deck, the underside should be examined and any badly sagged beams should be faired by flame heating their heels, or by shoring them temporarily.

It is possible that an area which is almost stress free will always be upset by heating it with a torch, but that an area with highly localized residual stress, as along one edge of a bar or angle, can be relieved of part of its previous shrinkage by the application of a limited amount of heat. This behavior should be studied by researchers.

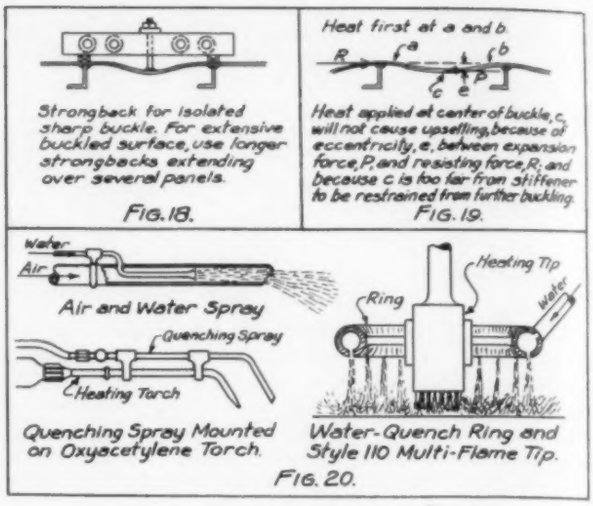
There is a lot of controversy over the advisability of heating directly opposite beams or stiffeners. It is not done much on light plating but is frequently done for 12.75-lb. plating and thicker. If the heat is applied for only a very short time, it may not raise the opposite surface of this thicker plating to a very high temperature, with the result that the heated side may be shrunk more and angular distortion at the fillet welds thus removed. Also, when rather sharp knuckles or angular distortions exist, along with the customary welts opposite these welds, they can hardly straighten out under the shrinkage forces of flame straightening unless they are heated to make them somewhat plastic.

Experience has shown that buckles which have been completely removed sometimes return in the same places later on. This can be caused by disturbances transmitted from other parts of the ship during welding or flame straightening, but often it is more likely the result of shrinking the plating in only one direction (perhaps overshrinking it in that direction), when it should have been shrunk in two directions. The use of some cross heats (rows of spots or lines across the panel of plating), in conjunction with the lines or rows running the length of the panel, seems to furnish the shrinkage in the other direction which is needed to hold the plating fair. One heater leaderman feels that by heating two vertical rows of spots at the same time, alternating back and forth between them (one row near each of two adjacent stiffeners), he prevents buckles from returning.

It seems that the shrinking must be enough to leave a little tension or drumheading in the plating to keep buckles from returning later. However, too much tension may cause distortion in adjacent parts of the ship. Sounding the plating with a hammer can be used to determine when all the slack has been pulled out and a reasonable amount of tension has been developed.

Most heaters have noticed at some time or other a behavior which they describe as "the life going out of the steel," which prevents it from responding to repeated applications of flame straightening on the same areas. This behavior should be investigated by controlled research experiments. It may be due partly to the fact that when mild steel (for example, with 0.25% carbon), is heated to a temperature slightly above the A_1 point in its critical range, and is then quenched, it loses a great deal of its ductility. Although it is not necessary to heat to such a temperature (about 1300° F., a very distinct dark red), this temperature and higher temperatures are common in practice. Also, a certain amount of cold work must enter into a flame straightening operation.

The steel "losing its life" in this manner seems to occur more frequently, if not altogether, when excessive heating temperatures are used, or when too large spots are heated, which causes local welts or deformations in the plating. These may introduce enough eccentricity to prevent an upsetting action which requires surrounding rigidity or restraint.


Strongback for isolated sharp buckle. For extensive buckled surface, use longer strongbacks extending over several panels.
FIG. 18.
Heat first at a and b.
Heat applied at center of buckle, c, will not cause upsetting, because of eccentricity, e, between expansion force, P, and resisting force, R; and because c is too far from stiffener to be restrained from further buckling.
FIG. 19.
Water
Air
Air and Water Spray
Quenching Spray
Heating Torch
Quenching Spray Mounted on Oxyacetylene Torch.
Heating Tip
Ring
Water
Water-Quench Ring and Style 110 Multi-Flame Tip.
FIG. 20.

Figs. 18, 19 and 20

There seems to be a kind of critical point in the amount of distortion in a bulkhead or deck, beyond which fairing by flame straightening becomes much more expensive and time consuming. This may be the point where the buckling becomes more of the nature of permanent set (plastic distortion), rather than just elastic springing out of line.

Some shipyards make a practice of shrinking virtually all decks and bulkheads by heating, even though some of them are well within reasonable tolerances. This seems to be a bad mistake. It often leads to overshrinking surfaces that were quite fair at the beginning, and starts a lot of trouble. Also, if bulkheads that really need fairing are faired to too close tolerances, overshrinking and resulting distortion in other nearby parts are likely to occur.

Fairing by shrink welding has been done to a very limited extent. It is not considered efficient and when surfaces are exposed to view, the weld beads added for shrinking must be chipped and ground off.

It is not easy to evaluate accurately the effectiveness of flame straightening methods as employed in various shipyards, because different types of vessels are being built and also the control of welding to prevent distortion is much better in some yards than in others. Some measure of the effectiveness of overall control is furnished by the relation of number of welding operators to number of heaters employed. In several yards from which data was gathered this ratio varied from 27:1 to 39:1 and in another yard where no superstructures were being built at the time, the ratio was 112:1. Another good rough index of overall efficiency in the use of all oxyacetylene processes is the cubic feet of oxygen consumed per ton of steel, which apparently should run well below 400 for Liberty ships.

Restraint Is Necessary in Flame Straightening

When no strongbacks and beating or jacking or other external forces are used, the assembly being flame straightened must be stiff enough locally to provide the reactions necessary to produce upsetting. Heat is not effective when applied at the center of a buckle as at *c* in Fig. 19. The eccentricity, *e*, between force, P, and reaction, R, is so great that the plating will merely spring out more instead of being upset. Therefore the heat must be applied first at points nearer the stiffeners or

beams which give the plating some resistance. After this, if more heats are required, it is best to work in from the edges of the buckle toward its center, with successively applied spots or lines of heat, as the edges are thus brought into line and the eccentricity, *e*, thereby reduced. The use of too large spots or too wide lines of heat detracts from the necessary restraint from surrounding areas.

If edges of door cuts are provided with temporary stiffeners, they can be faired more easily. It should help to install these prior to making the door cuts. Heavy rings clamped around port holes facilitate fairing of their edges. A ring of spot heats is made around the hole, close to the clamping ring.

If edges of door cuts are not stiffened before fairing, the heating must be done very carefully. If the applied heat is low enough, toilet and shower enclosures of very thin metal can be faired without additional temporary boundary stiffeners.

At a rounded corner where two bulkheads meet there is usually a vertical butt weld which will cause distortion near the corner, unless suitable strongbacks have been used in welding to stiffen the corner and the plating on both sides of the butt. In fairing the bulkheads at such rounded corners the heated areas must not be too close to the corner or the shrinkage will tend to flatten out the curved plating on one side of the corner and produce sharper curvature around near the other side. It may be necessary to strongback the corner if there is sharp distortion to be removed at the butt weld.

Temperature and Heat Input

The most common mistake made in flame straightening is "overshrinking" due to the use of too much heat and heating to too high a temperature, which is not only less efficient, but may actually begin to cause more local distortion if allowed to rise much above 1200° F. or a dull red. In the most effective method that has been observed by the writer, the torch is applied only a few seconds for each spot of heat and no color at all can be seen from the opposite side of the plating, even though there is no daylight on that side. Shipyards using these low temperatures for flame straightening, fair bulkheads quickly and in most cases with only a few spots of heat along a line near each stiffener, as compared with a gridwork of spots on 3-in. centers covering almost the entire area of a bulkhead, which is commonly seen in some yards. Although differences in the amount of welding distortion to be removed must be taken into consideration, this evidence in favor of low temperature seems indisputable with reference to flame straightening without the use of strongbacking, hammering or jacking.

Data on physical properties of plain carbon steel at elevated temperatures, as given on pp. 32 to 34, 1085 and 1086 of the 1942 *A. W. S. Handbook*, seem to account for the behavior as observed. Above 600° F., the yield point, tensile strength and modulus of elasticity drop rapidly. Above 900° F. extensive creep takes place and at 1200° F. there is practically no elastic behavior, and plastic yield or upsetting occurs with little internal force. Any greater amount of expansion produced by higher temperatures is not very effective. This may be because the modulus of elasticity, and therefore the stiffness of the plating has become so low that the needed restraint is not provided for upsetting. Any further upsetting that does take place seems to simply raise welts on the plating and does only harm.

Also, by keeping the temperature below the critical range of the steel, any danger of causing undesirable hardness and loss of ductility is precluded, even though the rate of cooling, as accelerated by quenching, reaches the critical rate. When hot working with a maul and flatter, and higher temperatures are used, it is advisable and usually convenient to withhold quenching until the steel has cooled enough that it does not show color.

A slightly longer application of the heating torch is required to obtain the proper temperature in heavier plating and at stiffeners or floor beams, than away from them or in lighter plating. Also where there is greater stiffness, somewhat larger spots or wider lines can be heated.

However, too much heat at almost any location has the tendency to simply expand the plating instead of upsetting it, and to push the buckles into adjacent panels, or sometimes into panels some distance away. Heaters have found it best to work clear across a bulkhead and then come back later with additional heats if necessary, rather than to keep on heating in one panel until it is entirely faired.

Some crews have used a quenching spray on the stiffener side of the plating when heating opposite stiffener webs. This has the effect of keeping the heat from becoming as intense on the stiffener side and may help to remove angular distortion. Others seem to accomplish the same results by heating to a lower temperature without cooling on the opposite side.

All evidence seems to be in favor of the lower temperatures. It is sometimes difficult to enforce their use because a heater naturally feels that he is accomplishing more when he can see a brightly heated area, and he may have a background of experience in blacksmith methods of straightening which are really expedited by such higher temperatures.

Quenching

It is obvious that quenching speeds up the work of flame straightening because it is not necessary to wait for a heated area to air cool, before heating an adjacent area. If, in welding, the keeping of local areas near the welds hot and plastic as long as possible permits the upset metal to stretch back again plastically upon cooling, then it is logical that locking in an upset condition by rapidly cooling or quenching a flame-heated area would increase the effect desired in flame straightening.

In line heating, the water spray follows along about 2 in. behind the heating torch to provide this quenching, but the speed (and consequently the rate of heat input) should be regulated so that no long area behind the torch remains hot enough to stay dry under the spray. For thin plating the quenching spray is sometimes kept as close as one inch behind the torch.

With a ring spray mounted upon and surrounding the heating tip, as used in some shipyards for making spot heats, the adjacent metal is kept cool during heating and the desired localization of heat is somewhat facilitated. Sometimes a separate spray operated by a helper is played around a spot while it is being heated, as well as during cooling.

A quenching spray, following behind a cutting torch, has been used in some yards to shrink edges of door cuts to prevent buckles in them.

Practice is about evenly divided between the use of a small stream or heavy spray of water, alone, and a combined spray of air and water. Some yards use only a jet of compressed air for quenching. In quenching with a spray of water, both the heat conductivity of the water and the latent heat of evaporation are factors. Some experimental work is desirable to determine the best

practice. The air and water spray has the advantage over a stream of water, that it can be directed more accurately, and also it does not create a sloppy or slippery condition on the decks.

Patterns of Applied Heat

For light plating, say of 10.2 lb. or less, spot heating is used much more than line heating, and the spots are first applied along lines parallel to stiffeners or deck beams and about 3 or 4 in. away from the stiffeners or beams, although this distance can be reduced if the temperature of heating is held down.

If the heats are applied too close to the web of a beam or stiffener (as in the case of a heater using higher temperatures and attempting to follow a line directly opposite the web, but running off that line), the plating will sink or knuckle sharply. Similar occurrences are the buckling up of plating between increments of intermittent stiffener welds or the sinking or bulging of plating between the teeth of serrated deck beams. This has not been observed when heating temperatures are held down.

Both line heats, opposite beams or stiffeners, and spot heats are commonly used for heavier plating. When there is a short faying flange on the beam or frame or stiffener, and the connecting fillet welds are not so close together, two lines of heat are sometimes used, one directly opposite each weld.

Spot heats in light plating are held to the size of a quarter or even less. For heavy deck plating they are sometimes made as large as 2 in. in diameter. Line heats can be weaved and widened out somewhat in heavy plating but a width of more than about 1 in. does not seem advisable according to most experience.

Heated areas should never extend closer than 6 or 8 in. from boundaries, because they have already been shrunk by the welding.

When buckles run almost the full length of a panel, spots or lines of heat are run over almost the full length. When the buckles are short it is advisable to begin the heats some distance below the buckles and extend them somewhat beyond it. Cross heats, a short distance below such a buckle and a short distance above it, help to remove it.

After heating near stiffeners or beams has been carried out throughout quite an area, if some buckles still remain, it is necessary to come back and do more shrinking by adding a second row of spots or lines of heat, out further from the beams or stiffeners. Occasionally it is necessary to do still further heating in a panel, working in toward the center of the buckle from its edges, applying a grid of lines or spots (Fig. 17), or perhaps arranging the spots in concentric circles or in the form of a cross. The main thing is to work in toward the center of the buckle with the successive heats.

Flame Straightening Sequence

It is very difficult to plan a sequence of flame straightening and then to follow it, because of the different conditions of distortion that occur in various vessels, even though they are identical. Also, flame straightening must be coordinated with fitting-out operations and joiner work, which are difficult to hold to an exact schedule or sequence. If possible, the flame straightening sequence should be interwoven with the welding sequence.

It is usually possible to follow some general principles regarding sequence. As a general rule, it is best to fair heavier parts such as decks above and below, before fairing bulkheads, because lighter bulkheads have less stiffness and are likely to be distorted by flame straightening of decks to which they are welded. Decks are sometimes distorted by the fairing of heavier adjacent shell plating.

If there is only an occasional panel of a bulkhead or deck that is buckled, fairing can be started in the next adjacent panels on either side, if sounding them with a hammer shows them to be fairly tight. Sounding in this way can be used to determine the extent of the area to be covered with heats in any one panel, where buckling is round or localized.

When distortion is not bad but extends throughout a bulkhead or deck, heats in the plating along alternate stiffeners or deck beams will often be sufficient.

Sharp kinks or knuckles, which require force and hot straightening, should be removed before flame straightening is started, and preferably even before erection.

Flame Straightening Technique

It is important to standardize upon a technique of flame straightening that will avoid an idle flame burning in the air, which can waste tremendous quantities of oxygen and acetylene. Also shutting off and relighting torches waste some gases, as coinpared with a coordination of heating and quenching which permits virtually continuous application of the flame to the plating.

If shrinking by spot heats is carried along near two stiffeners or deck beams at the same time, the heater and quencher can alternate back and forth between the two rows of spots with very little idle torch time (Fig. 15). When the quenching tip is mounted on the torch, as in line heating on decks, gases can be saved by working a helper with a second, separate spray to function in lieu of the heater shutting off his torch occasionally and continuing with the quenching spray alone. When temperatures and heats are held down, one helper can probably keep up with two heaters under this arrangement, or possibly the separate quenching spray will not be necessary at all with lower heats produced by faster travel and smaller heating tips.

In shrinking flanges of stiffeners or beams with very thin webs, to take out bowing or sagging of them after the erection of bulkheads or decks, too much heating in one application can cause the webs to buckle. The straightening can be done with less heating if a mechanical strain is first put on the member as by shoring under beams or jacking against stiffeners.

There is quite a variation in the sizes of heating torches and tips as used in practice. For flame straightening light plating, without force, it is most common to use single flame tips with orifices ranging from No. 48 to No. 40 drill size, which consume from 30 to 60 cubic feet of acetylene per hour, operating on medium positive pressure, or small multiflame tips of approximately the same consumption. For very heavy plating a single flame tip with orifice of about No. 30 drill size is used, consuming from 70 to 100 cubic feet of acetylene per hour, or perhaps a large multiflame tip of equivalent consumption. A general purpose torch is used most commonly, along with an adapter for large multiflame tips, if necessary. Occasionally, heavy duty torches are used where the heating is being done on horizontal surfaces. The heat-transferring efficiency of a multiple flame tip is better than that of a single flame tip, and the multi-flame tip operates on a lower acetylene pressure; but it must be used carefully to avoid overheating, or

torches burning while idle, which results in a large waste of oxygen and acetylene.

In general, a larger tip and a shorter application of heat will give the desired highly localized heating effect, and is best, up to the point where heat-transferring efficiency falls off seriously or temperature of heating cannot be held low enough, as in light plating.

In Fig. 20 is sketched an air and water spray device which is designed for operation separately by a helper. A lighter device is used when it is mounted on the heating torch, especially if the assembly is to be used on vertical surfaces. For heating decks, the assembly can be mounted upon a pair of small wheels and rolled along the deck to relieve the operator of fatigue.

The variations in practices which have been described are so wide that their effectiveness must vary even more than is obvious from visual inspection during production, without taking measurements and carrying out some carefully controlled experiments.

Supervision and Instructions

There is no simple answer to the problem of distortion control. As in the case of any other item of good workmanship, it requires careful supervision and vigilance all along the line of production operations. When work is paid for by piece-rates, or when special campaigns are set up to gain large footages of welding, supervision must be made tighter.

The best results are being realized by departments that have simple, easily understandable, written instructions and completely standardized welding and flame-straightening procedures, all well illustrated, to furnish to production forces. These should cover items like approximate number and locations of dogs, strongbacks, lifting pads, temporary braces or stiffeners, etc., as well as details and sequence of welding and flame straightening.

Welding superintendents and foremen should be relieved of routine clerical and office duties, with which they are often saddled, so they can spend most of their time out on the construction work to see that standard practices are enforced.

One of the most important things is to provide welding operators with gages for weld size and to see that these are used. Oversize welds increase distortion to a surprising degree. In most shipyards much attention has been given to avoiding waste involved in rejecting long stub ends of electrodes. The insidious, greater waste of time and labor, as well as electrodes, through the making of oversize welds, too often goes by unnoticed.

Confronted with a countless number of general organization problems in connection with such a rapidly expanded program, shipbuilders have found it difficult to give as much attention to some details of the work as they would normally devote to such matters, but they are striving earnestly to conserve strategic materials and to lower costs by reducing man-hours of labor and eliminating waste. American shipbuilders must be accorded the highest praise, not only for the undreamed of speed at which they are producing ships for victory, but also for the quality of their ships, as attested by the excellent performance of those already in service, delivering war supplies, materials and personnel to all parts of the world.

Without the use of arc welding and oxyacetylene processes to take the place of machine tool operations, such rapid expansion and speed in shipbuilding would have been impossible. Development of the use of these processes in building merchant ships, which has made them readily available in the present crisis, is due in no small part to the progressive and far-sighted policy of the American Bureau of Shipping, in encouraging this development throughout the last fifteen years.

Grateful acknowledgment is made of assistance given to the writer by welding and heating foremen and leadermen in shipyards throughout the country, all of whom have been glad to contribute their experience most freely toward a rational solution of distortion problems in shipbuilding. Acknowledgment is also made of the courtesy of the Ingalls Shipbuilding Corporation, the California Shipbuilding Corporation, West Coast Kaiser shipyards and the United States Maritime Commission, in providing for the obtaining and use of photographs for illustrations.

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Preheat Temperatures

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(*Chart on next page*)

METAL GROUP	METAL DESIGNATION	APPROXIMATE COMPOSITION — PERCENT								METAL DESIGNATION	RECOMMENDED PREHEAT
		C.	Mn.	Si.	Cr.	Ni.	Mo.	Cu.			
PLAIN CARBON STEELS	PLAIN CARBON STEEL	BELOW .20								PLAIN CARBON STEEL	UP TO 200°F
	PLAIN CARBON STEEL	.20-.30								PLAIN CARBON STEEL	200°F-300°F
	PLAIN CARBON STEEL	.30-.45								PLAIN CARBON STEEL	300°F-500°F
	PLAIN CARBON STEEL	.45-.80								PLAIN CARBON STEEL	500°F-800°F
CARBON MOLY STEELS	CARBON MOLY STEEL	.10-.20					.50			CARBON MOLY STEEL	300°F-500°F
	CARBON MOLY STEEL	.20-.30					.50			CARBON MOLY STEEL	400°F-600°F
	CARBON MOLY STEEL	.30-.35					.50			CARBON MOLY STEEL	500°F-800°F
MANGANESE STEELS	SILICON STRUCTURAL STEEL	.35	.80	.25						SILICON STRUCTURAL STEEL	300°F-500°F
	MEDIUM MANGANESE STEEL	.20-.25	1.0-1.75							MEDIUM MANGANESE STEEL	300°F-500°F
	SAE T 1330 STEEL	.30	1.75							SAE T 1330 STEEL	400°F-600°F
	SAE T 1340 STEEL	.40	1.75							SAE T 1340 STEEL	500°F-800°F
	SAE T 1350 STEEL	.50	1.75							SAE T 1350 STEEL	600°F-900°F
	12% MANGANESE STEEL	1.25	12.0							12% MANGANESE STEEL	USUALLY NOT REQUIRED
HIGH TENSILE STEELS (SEE ALSO STEELS BELOW)	MANGANESE MOLY STEEL	.30	1.65	.20			.35			MANGANESE MOLY STEEL	300°F-500°F
	JALTEN STEEL	.35 MAX.	1.50	.30				.40		JALTEN STEEL	400°F-600°F
	MANTEN STEEL	.30 MAX.	1.35	.30				.20		MANTEN STEEL	400°F-600°F
	ARMCO HIGH TENSILE STEEL	.12 MAX				.50 MIN.	.05 MIN.	.35 MIN.		ARMCO HIGH TENSILE STEEL	UP TO 200°F
	DOUBLE STRENGTH #1 STEEL	.12 MAX.	.75			.50-1.25	.10 MIN.	.50-1.50		DOUBLE STRENGTH #1 STEEL	200°F-600°F
	DOUBLE STRENGTH #1A STEEL	.30 MAX.	.75			.50-1.25	.10 MIN.	.50-1.50		DOUBLE STRENGTH #1A STEEL	400°F-700°F
	MAYARI R STEEL	.12 MAX.	.75	.35	.2-1.0	.25-.75		.60		MAYARI R STEEL	UP TO 200°F
	OTISCOLOY STEEL	.12 MAX.	1.25	.10 MAX.	.10 MAX.			.50 MAX.		OTISCOLOY STEEL	200°F-400°F
	NAX HIGH TENSILE STEEL	.15-.25		.75	.60	.17	.15 MAX.	.25 MAX.	Zr. .12	NAX HIGH TENSILE STEEL	UP TO 300°F
	CROMANSIL STEEL	.14 MAX.	1.25	.75	.50					CROMANSIL STEEL	300°F-400°F
	A. W. DYN-EL STEEL	.11-.14						.40		A. W. DYN-EL STEEL	UP TO 300°F
	CORTEN STEEL	.12 MAX.		.25-1.0	.5-1.5	.65 MAX.		.40		CORTEN STEEL	200°F-400°F
	CHROME COPPER NICKEL STEEL	.12 MAX.	.75		.75	.75		.55		CHROME COPPER NICKEL STEEL	200°F-400°F
	CHROME MANGANESE STEEL	.40	.90		.40					CHROME MANGANESE STEEL	400°F-600°F
	YOLOY STEEL	.05-.35	.3-1.0			1.75		1.0		YOLOY STEEL	200°F-600°F
	HI-STEEL	.12 MAX.	.6	.3 MAX.		.55		.9-1.25		HI-STEEL	200°F-500°F
NICKEL STEELS	SAE 2015 STEEL	.10-.20				.50				SAE 2015 STEEL	UP TO 300°F
	SAE 2115 STEEL	.10-.20				1.50				SAE 2115 STEEL	200°F-300°F
	2½% NICKEL STEEL	.10-.20				2.50				2½% NICKEL STEEL	200°F-400°F
	SAE 2315 STEEL	.15				3.50				SAE 2315 STEEL	200°F-500°F
	SAE 2320 STEEL	.20				3.50				SAE 2320 STEEL	200°F-500°F
	SAE 2330 STEEL	.30				3.50				SAE 2330 STEEL	300°F-600°F
	SAE 2340 STEEL	.40				3.50				SAE 2340 STEEL	400°F-700°F
MEDIUM NICKEL CHROMIUM STEELS	SAE 3115 STEEL	.15			.60	1.25				SAE 3115 STEEL	200°F-400°F
	SAE 3125 STEEL	.25			.60	1.25				SAE 3125 STEEL	300°F-500°F
	SAE 3130 STEEL	.30			.60	1.25				SAE 3130 STEEL	400°F-700°F
	SAE 3140 STEEL	.40			.60	1.25				SAE 3140 STEEL	500°F-800°F
	SAE 3150 STEEL	.50			.60	1.25				SAE 3150 STEEL	600°F-900°F
	SAE 3215 STEEL	.15			1.00	1.75				SAE 3215 STEEL	300°F-500°F
	SAE 3230 STEEL	.30			1.00	1.75				SAE 3230 STEEL	500°F-700°F
	SAE 3240 STEEL	.40			1.00	1.75				SAE 3240 STEEL	700°F-1000°F
	SAE 3250 STEEL	.50			1.00	1.75				SAE 3250 STEEL	900°F-1100°F
	SAE 3315 STEEL	.15			1.50	3.50				SAE 3315 STEEL	500°F-700°F
	SAE 3325 STEEL	.25			1.50	3.50				SAE 3325 STEEL	900°F-1100°F
	SAE 3435 STEEL	.35			.75	3.00				SAE 3435 STEEL	900°F-1100°F
	SAE 3450 STEEL	.50			.75	3.00				SAE 3450 STEEL	900°F-1100°F
MOLY BEARING CHROMIUM AND CHROMIUM NICKEL STEELS	SAE 4140 STEEL	.40			.95		.20			SAE 4140 STEEL	600°F-800°F
	SAE 4340 STEEL	.40			.65	1.75	.35			SAE 4340 STEEL	700°F-900°F
	SAE 4615 STEEL	.15				1.80	.25			SAE 4615 STEEL	400°F-600°F
	SAE 4630 STEEL	.30				1.80	.25			SAE 4630 STEEL	500°F-700°F
	SAE 4640 STEEL	.40				1.80	.25			SAE 4640 STEEL	600°F-800°F
	SAE 4820 STEEL	.20				3.50	.25			SAE 4820 STEEL	600°F-800°F
LOW CHROME MOLY STEELS	2% Cr.-⅓% Mo. STEEL	UP TO .15			2.0		0.5			2% Cr.-⅓% Mo. STEEL	400°F-600°F
	2% Cr.-⅓% Mo. STEEL	.15-.25			2.0		0.5			2% Cr.-⅓% Mo. STEEL	500°F-800°F
	2% Cr.-1% Mo. STEEL	UP TO .15			2.0		1.0			2% Cr. 1% Mo. STEEL	500°F-700°F
	2% Cr.-1% Mo. STEEL	.15-.25			2.0		1.0			2% Cr. 1% Mo. STEEL	600°F-800°F
MEDIUM CHROME MOLY STEELS	5% Cr.-½% Mo. STEEL	UP TO .15			5.0		0.5			5% Cr.-½% Mo. STEEL	500°F-800°F
	5% Cr.-½% Mo. STEEL	.15-.25			5.0		0.5			5% Cr.-½% Mo. STEEL	600°F-900°F
	8% Cr.-1% Mo. STEEL	.15 MAX.			8.0		1.0			8% Cr.-1% Mo. STEEL	600°F-900°F
PLAIN HIGH CHROMIUM STEELS	12-14% Cr. TYPE 410	.10			13.0					12-14% Cr. TYPE 410	300°F-500°F
	16-18% Cr. TYPE 430	.10			17.0					16-18% Cr. TYPE 430	300°F-500°F
	23-30% Cr. TYPE 446	.10			26.0					23-30% Cr. TYPE 446	300°F-500°F
HIGH CHROME NICKEL STAINLESS STEELS	18% Cr. 8% Ni. TYPE 304	.07			18.0	8.0				18% Cr. 8% Ni. TYPE 304	USUALLY DO NOT REQUIRE PREHEAT BUT IT MAY BE DESIRABLE TO REMOVE CHILL
	25-12 TYPE 309	.07			25.0	12.0				25-12 TYPE 309	
	25-20 TYPE 310	.10			25.0	20.0				25-20 TYPE 310	
	18-8 Cb. TYPE 347	.07			18.0	8.0			Cb. 10XC	18-8 Cb. TYPE 347	
	18-8 Mo. TYPE 316	.07			18.0	8.0	2.5			18-8 Mo. TYPE 316	
	18-8 Mo. TYPE 317	.07			18.0	8.0	3.5			18-8 Mo. TYPE 317	
IRONS	CAST IRON									CAST IRON	700°F-900°F
	Ni RESIST									Ni RESIST	500°F-1000°F
NON FERROUS	ALUMINUM									ALUMINUM	500°F-700°F
	MONEL									MONEL	200°F-300°F
	NICKEL									NICKEL	200°F-300°F
	INCONEL									INCONEL	200°F-300°F
	COPPER									COPPER	500°F-800°F
	ZINC									ZINC	200°F-300°F

A portion of the Tempil Preheating Chart

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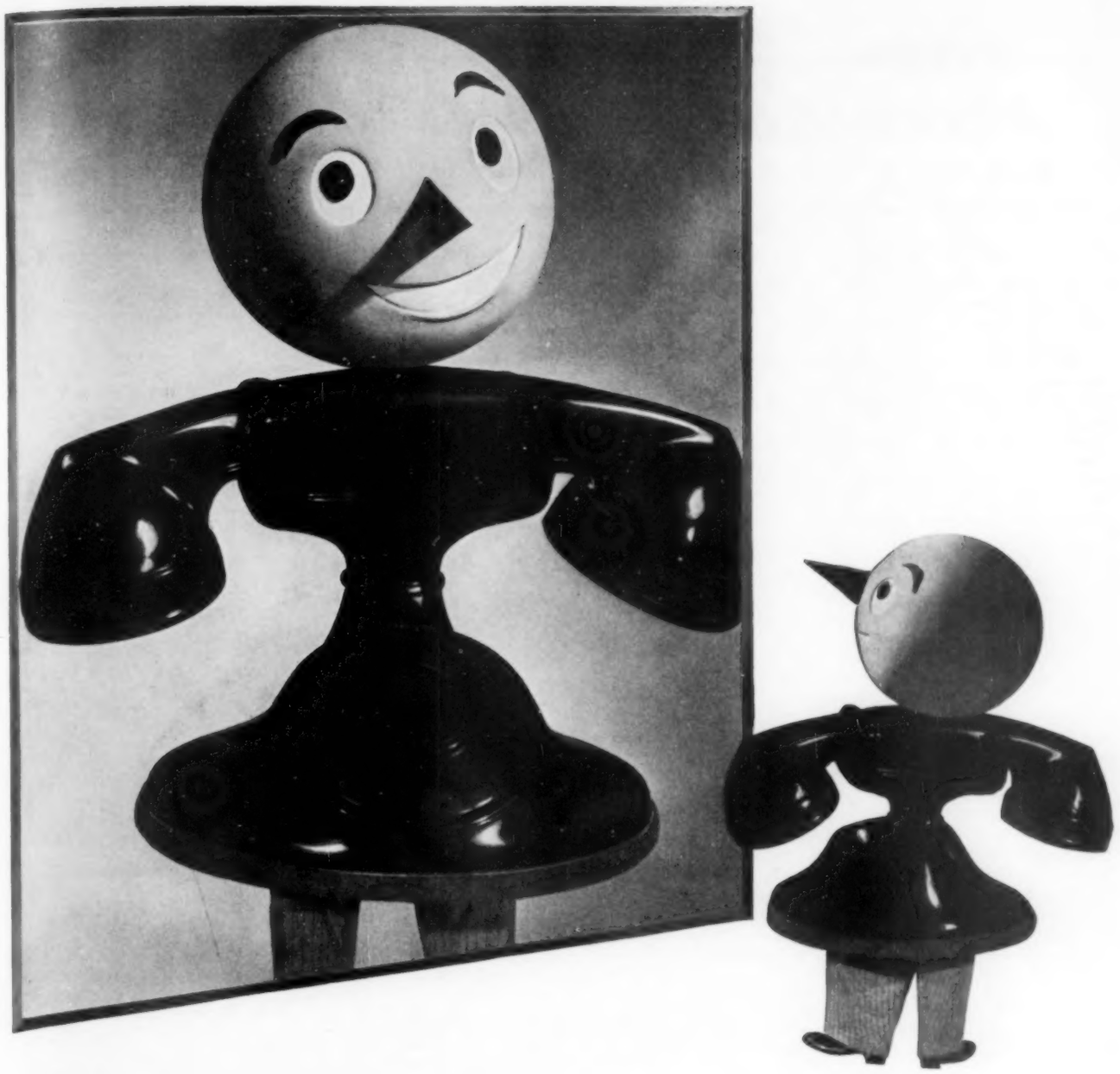


"If I were twice as big"

"Then I could give the public all the service it wants and take care of the war on top of that.

"But I can't get bigger now because materials are needed for shooting. So I'm asking your help to make the most of what we have.

"Please don't make Long Distance calls to centers of war activity unless they are vital. Leave the wires clear for war traffic."

BELL TELEPHONE SYSTEM

THE AMERICAN WELDING SOCIETY

ACTIVITIES — RELATED EVENTS

ANNUAL MEETING

The 23rd Annual Meeting of the AMERICAN WELDING SOCIETY closed in Cleveland, October 15, and in many respects, surpassed previous records.

The AMERICAN WELDING SOCIETY came into existence as a result of activities during the last war. This Annual Meeting marked the first meeting of the Society during a war period. Although the sessions were curtailed as to number, nevertheless, the attendance at all technical meetings broke all records. The meeting rooms were well filled and in some instances standing room only could be provided for late comers.

The total registration of 1200 was under the record set for several past years.

The absence of all frills and entertainment lent a somber atmosphere to the sessions in keeping with war times. Many of the Annual Meeting papers appeared in the October issue; others were available in Preprint form and will be reproduced later in the JOURNAL. Still others appear in the current issue.

The awards of Medals and Prizes are described elsewhere.

A very successful Section Officers Conference was held Wednesday evening at which more than three-quarters of the Sections of the Society were represented by one or more officers. The Research sessions on Monday evening and Tuesday evening were well attended as were, also, the special educational motion pictures on Monday evening. At this session, an explanation was given of the operation of the Welding Section of the WPB and an opportunity was provided to members of the Society to ask questions and learn how this organization operated.

The Business Meeting and meeting of the Board of Directors was held on Thursday afternoon just before the close of the Annual Meeting.

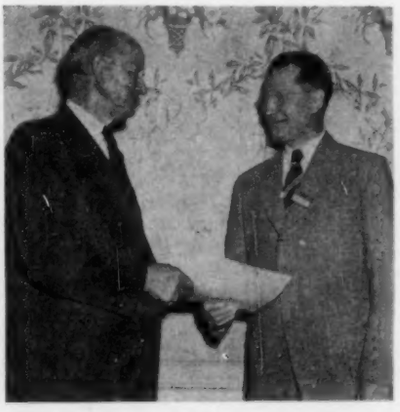
The Society owes a debt of gratitude for the time and effort of many members in making the 1942 Annual Meeting a grand success. At the Business Meeting, special mention was made of the work of Mr. E. V. David, Chairman of the Convention Committee; Mr. David Arnott, Chairman of the Program Committee; members of the Cleveland Section, including Messrs. Kriz, Wagner, Wyss and Pfeil. Special mention was made of the publicity activities of Mr. Powers and the work of the Manufacturers Committee under the leadership of Mr. C. I. MacGuffie.

PRESENTATION OF MEDALS AND AWARDS

Presentation of the 1941 Samuel Wylie Miller Memorial Award, The Lincoln Gold Medal Award for 1941–42 and the annual award of prizes by the Resistance Welder Manufacturers' Association featured the opening session of the 23rd Annual Meeting of the AMERICAN WELDING SOCIETY in Cleveland on October 12th, at Hotel Cleveland.

The award of the Miller Medal was made for the most conspicuous contribution to research, standardization and advancement of welded construction.

Recipient of the Miller Award was Mr. H. C. Boardman, research engineer with the Chicago Bridge and Iron Company, Chicago, Ill.



Dr. Comfort A. Adams presents the Samuel Wylie Miller medal to H. C. Boardman, research engineer, Chicago Bridge and Iron Company, Chicago, Illinois

Mr. Boardman received his engineering education at the University of Illinois. After graduation, he joined the Chicago Bridge and Iron Company, where he became chief draftsman. From 1917 to 1919 he served in the first World War, advancing in successive steps from private to major. After a short period in automotive accessory business, Boardman joined the International Filter Co. of Chicago as engineer and superintendent of construction. He then returned to the University of Illinois as instructor in civil engineering from 1924 to 1926. For the past 16 years he has been research engineer with the Chicago Bridge and Iron Company.

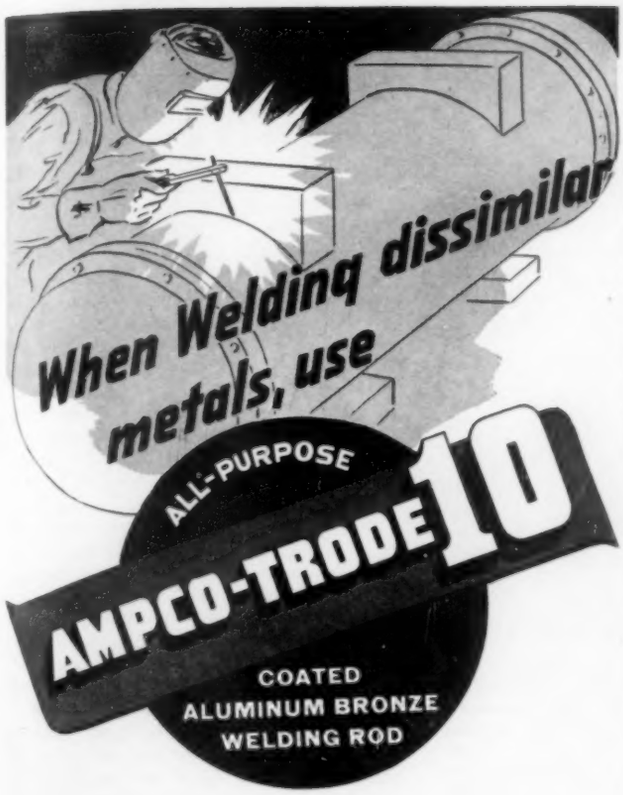
Boardman's activities in the engineering field are indicated through his affiliation with many societies and clubs. He is past-president of the AMERICAN WELDING SOCIETY; has memberships in the A.S.M.E. Boiler Code Committee; Western Society of Engineers; American Society of Civil Engineers; American Society for Metals; Chairman, Fundamental Research Division of the Welding Research Committee of Engineering Foundation; and member, National Research Council, Division of Engineering and Industrial Research. He has authored many technical articles for magazines and handbooks.

Award of the Lincoln Gold Medal, donated to the AMERICAN WELDING SOCIETY by Mr. James F. Lincoln, president of The Lincoln Electric Company, Cleveland, Ohio, was made to Messrs. George A. Ellinger, A. G. Bissell and Morgan L. Williams, co-authors of the paper entitled, "The Tee-Bend Test to Compare the Welding Quality of Steels," published in THE WELDING JOURNAL, and judged the greatest contribution to the advancement and use of welding for the year. Each man received a medal.

Dr. Wendell F. Hess, Rensselaer Polytechnic Institute, Troy, New York, presents Lincoln Gold Medals to, (left to right), G. A. Ellinger, metallurgist, National Bureau of Standards, Washington, D. C.; A. G. Bissell, senior welding engineer, Bureau of Ships, U. S. Navy Department, Washington, D. C.; and Morgan L. Williams, also of the Bureau of Standards

Mr. Ellinger is a graduate of Pennsylvania State College where he received his B.S. degree. He spent a year as metallurgist in the test department of The Standard Steel Works Company at Burnham, Pa., and two years as metallurgist with the Atchison, Topeka and Santa Fe Railway Co., Topeka, Kans. Then followed 5 years as chief chemist and metallographer at the Page Steel and Wire Co., Monessen, Pa. In 1929 he was appointed to the staff of the Metallurgy Division, National Bureau of Standards, Washington, D. C., and for the past 9 years has devoted considerable time to weldability research in cooperation with the Bureau of Ships, Navy Department.

Mr. Bissell's activities in connection with welding date back to 1918, when he was detailed to investigate the possible uses of arc welding at the Puget Sound Navy Yard. As metallurgist there, he developed the training of operators and organization of the Hull Division Welding Shop. To obtain his degree as chemical engineer, Mr. Bissell prepared what was believed to be the first thesis on welding



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A full line of Ampco-Trode welding rods are also made of Ampco Metal. This is a high strength series with a wide range of hardness and excellent bearing characteristics.

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to be accepted for an advanced degree. During the early development of structural steel welding, he participated in the design and erection of the first all-welded buildings of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa., and the first all-welded through plate girder railroad bridge at Turtle Creek, Pa. He was later appointed sales engineer for the Star Machinery Company of Seattle, Washington, handling welding equipment. For the past 7 years he has been with the Navy Department, and is at present in charge of supervision of the Welding and Castings Section of the Bureau of Ships. A member of the Board of Directors of the AMERICAN WELDING SOCIETY, Mr. Bissell has been instrumental in building the Washington section of the AMERICAN WELDING SOCIETY to its present high standing.

Mr. Williams received his A.B. degree at Ripon College, Ripon, Wis., in 1928. Later he attended Brown University where he obtained a Ph.D. in physics. After a short period as Junior Patent Examiner at the U. S. Patent Office, Washington, D. C., he was appointed assistant metallurgist, National Bureau of Standards, Washington, D. C., which post he holds at the present time. Mr. Williams is a member of the American Society for Metals and the American Physical Society.

Recipients of the annual award of the prizes by the Resistance Welder Manufacturers Association were: First Prize, $500, awarded to Mr. J. H. Cooper, The Taylor-Winfield Corporation, Warren, Ohio, for his paper entitled, "The Electrical Characteristics of Resistance Welders, and the Proximity Effect of Work Materials."

Mr. Cooper received his engineering training at the University of Missouri and Union College where he obtained his B.S. and M.S. degrees. After graduating, he spent 9 years with The General Electric Company where his interests were directed specifically to welding engineering as applied to arc welding. In his present capacity of welding engineer at The Taylor-Winfield Corporation, he is developing research in both resistance welding and arc welding. Cooper is a member of the AMERICAN WELDING SOCIETY and Association of Iron and Steel Engineers.

(Left to right), P. M. Hall, Taylor Hall Welding Co., Worcester, Mass., president of the Resistance Welder Manufacturer's Association, who presented the prizes; L. G. Levoy, General Electric Co., Schenectady, New York; R. P. Della-Vedowa, Lockheed Aircraft Corp., Burbank, Calif.; E. F. Holt, P. R. Mallory and Co., Indianapolis, Indiana; E. P. Gruca, Pullman Standard Car Manufacturing Co., Chicago, Illinois, and G. F. Jenks, retiring president of the Society

Second Prize, $250, was awarded to Messrs. F. R. Hensel, E. I. Larsen and E. F. Holt, all of P. R. Mallory and Company, Indianapolis, Ind., for co-authorship of a paper entitled, "Thermal Gradients in Spot Welding Electrodes."

Mr. Hensel, received his schooling in Saxony, England and Germany. At present he holds the posts of section engineer, Westinghouse Electric and Manufacturing Co. and metallurgical consultant for P. R. Mallory and Co., Inc. He has obtained over 100 U. S., British and Canadian patents on alloys and processes. He is a member of numerous technical societies and author of 20 or more scientific papers.

Mr. Larsen is a graduate of Carnegie Institute of Technology. He has served as research engineer at Westinghouse Electric and Manufacturing Co., metallurgical engineer for Driver-Harris, Harrison, N. J. He has been with P. R. Mallory and Co., Inc., since 1935. Mr. Larsen has also written numerous scientific papers and is the inventor and co-inventor of many nonferrous alloys and processes

Mr. Holt, a Drexel Institute graduate, has been with P. R. Mallory & Co., Inc., for 7 years where he now is senior research engineer. He is author and co-author of many papers on resistance welding research and holds several important patents at present, with others pending.

Third Prize, $100, was awarded to Mr. R. P. Della-Vedowa, Lockheed Aircraft Corp., Burbank, Calif., for his paper en-

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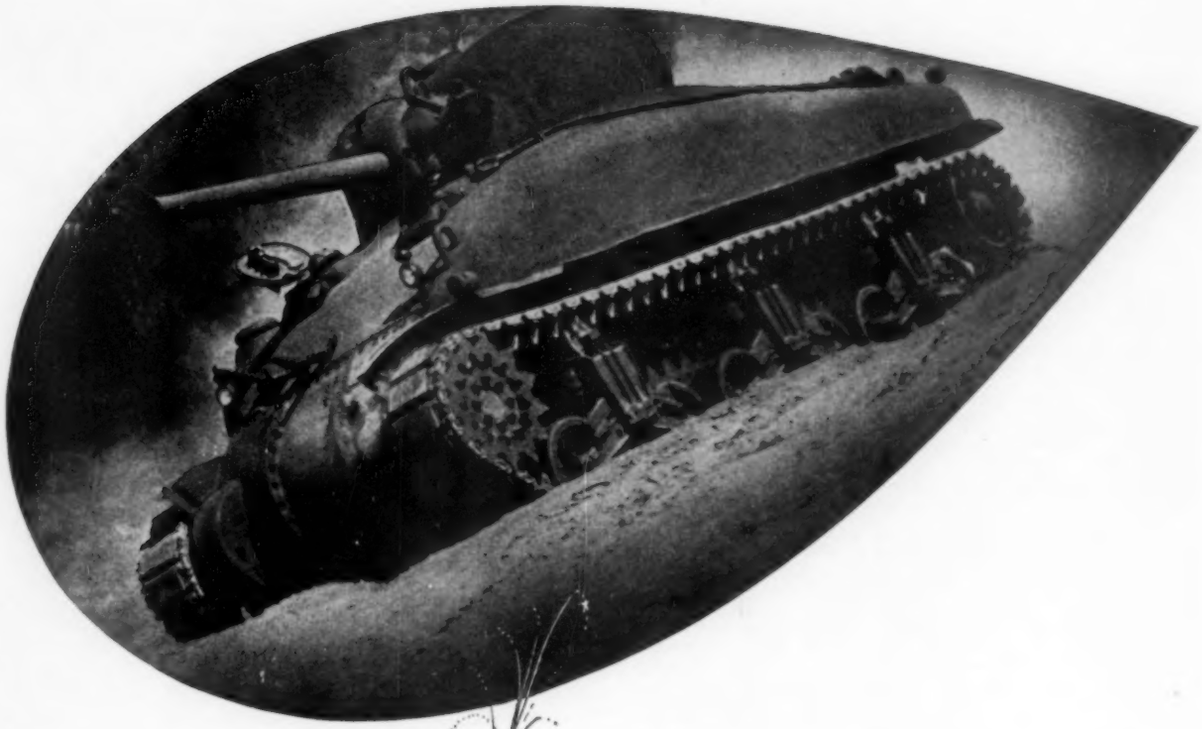

PAGE ELECTRODES

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titled, "Progress Report on the Use of Flash Welding as a Means of Fabricating Aircraft Structural Parts from X-4130 Steel."

A graduate of the University of California, Della-Vedowa enrolled as an engineering trainee at the Lockheed Aircraft Corp. at Burbank, Calif., in June 1940. After completing his training, he was assigned to the production research department of that company investigating various phases of resistance welding. He is a technical member of the Institute of the Aeronautical Sciences.

Fourth Prize, $50, was awarded to Mr. L. G. Levoy, General Electric Co., Schenectady, N. Y., for his paper entitled, "Voltage Variation Tolerance for A.-C. Resistance Welding."

After graduating from the University of Southern California where he received his B.S. degree, Mr. Levoy became a student engineer on the test course of the General Electric Company. Short assignments were given him there in research, switch gear and motor generator departments, and in the high-voltage laboratory. After taking General Electric's advance engineering course, Levoy became associated with the company's industrial control engineering department, specializing in electronic control for resistance welding. He is now associated with this department, specializing in industrial power generation and distribution. Several of his improvements in the industrial and electronic control field which may be applied to resistance welding systems, have been granted a patent.

Fifth Prize, $50, was awarded to Messrs. G. S. Mikhalapov and T. F. Falls, both of The Taylor-Winfield Corp., Warren, Ohio, for co-authorship of their paper, "Structural and Metallurgical Properties of Condenser Discharge Spot Welds."

Mr. Mikhalapov is particularly active in the affairs of the Society, being a member of the following committees: Definitions and Chart, Symbols, Standard Tests for Welds, Resistance Welding Standards and on the Subcommittee on Recommended Resistance Welding Procedures. He is also a member of the Metal Handbook Committee for the American Society for Metals.

Mr. Falls' engineering education was obtained at the University of Pennsylvania, Moore School and California Institute of Technology. His business experience was founded with the Brown Instrument Co., Philadelphia City Planning Commission, Southwark Division of the Baldwin Locomotive Works and The Taylor-Winfield Corp., Inc. As an associate member of the Southern California Meter Assn., Mr. Falls served on the educational committee. He also worked out numerous analytical mathematical studies with Dr. S. V. Lassen of Los Angeles, Calif.

Sixth Prize, $50, awarded to Messrs. A. M. Unger, H. A. Matis and E. P. Gruca, all of the Pullman Standard Car Mfg. Co. of Chicago, Ill., for their paper entitled, "Behavior of Spot Welds Under Fatigue Stresses."

Presentation of the Miller and Lincoln Medals and award of the prizes by the Resistance Welder Manufacturer's Association opened activities at what was probably the most interesting and extensive annual gathering of the AMERICAN WELDING SOCIETY.

PRESENTATION OF SAMUEL WYLIE MILLER MEMORIAL MEDAL AWARD

By C. A. Adams

Recipient: Mr. Harry C. Boardman

I am sure you will all join me in my deep regret that Dr. Jacobus, Chairman of the Committee on Awards, could not be here today to make this award. However, your loss is my gain, since this is a very delightful duty, not only because of the medalist, but also because it recalls so many happy associations with our dear old friend, Sam Miller.

The reasons for awarding a medal are numerous and the ways of stating them are often conventional and not always discriminative. Sometimes the medal reads "for meritorious achievement" in some particular field. The Miller Medal reads, "For conspicuous contributions to the art of welding." Personally, I like the word "service" and as I looked over the list of Miller medalists, I realized that the word "service" would better describe the contributions of a considerable number of the men on that list.

In some cases, this service is not conspicuous in the way of inventions or of startling discoveries. However, the most important service in the evolution of an art or of the corresponding society, is often

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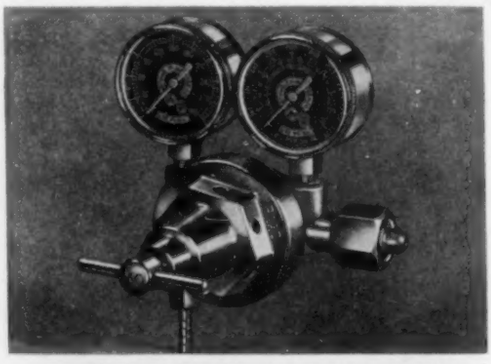

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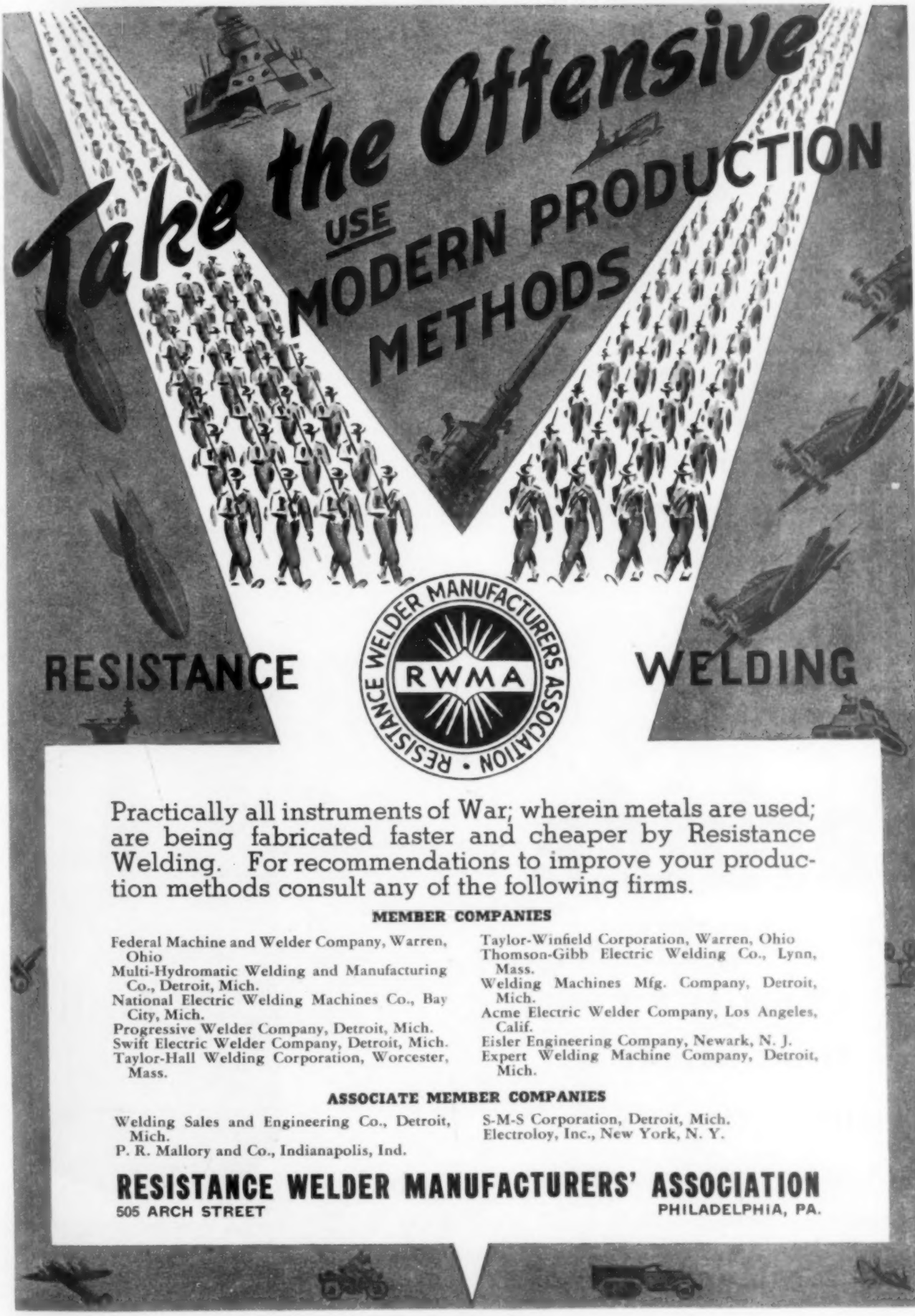

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S-M-S Corporation, Detroit, Mich.
Electroloy, Inc., New York, N. Y.

RESISTANCE WELDER MANUFACTURERS' ASSOCIATION
505 ARCH STREET PHILADELPHIA, PA.

H. C. Boardman

of an educational type, such as the long-continued impress of the fairmindedness, courage, unquestioned integrity and wise counsel of an outstanding personality. Even when dealing with technical problems this habit of clean, unbiased, straight thinking is of inestimable value. When this is coupled with real technical contributions often hidden from the public by the modesty of the individual, the pleasure of making the award is doubly great.

When long and intimate association has stirred one not only to keen admiration but also to deep affection, it is very difficult, for me at least, to find words adequate for the occasion.

Such is the man we are honoring today. In doing so, we are honoring ourselves and the AMERICAN WELDING SOCIETY.

Harry C. Boardman, in the name of the AMERICAN WELDING SOCIETY and on behalf of its Board of Awards, as a token of our high esteem and in sincere appreciation of the outstanding service which you have rendered both to the welding industry and to this Society, I take great pleasure in presenting to you the Samuel Wylie Miller Memorial Medal together with the Certificate of Award.

NEW DISTRICT VICE-PRESIDENT

Middle Western District—John D. Tebben

John Tebben was born on a farm in Wisconsin. He attended the University of Chicago and Northwestern University and joined the Mallory Company in 1933. Shortly thereafter he became Manager of the Detroit Office. In 1938 he returned to Indianapolis as General Sales Manager of the Metallurgical Division. John is a member of a number of organizations including the AMERICAN WELDING SOCIETY, the Society of Automotive Engineers, Engineering Society of Detroit (Charter Member), the Resistance Welder Manufacturers' Association, Phi Delta Gamma, Army Ordnance Association and the National Aeronautic Association.

Mr. Tebben has been an active member

John D. Tebben

of the AMERICAN WELDING SOCIETY for approximately a decade. He was Chairman of the Detroit Section; member of the Publicity Committee, and since 1941 Chairman of the Membership Committee. Through his activities and other members of the committee, the membership has grown steadily. John's outside interests are hunting and shooting.

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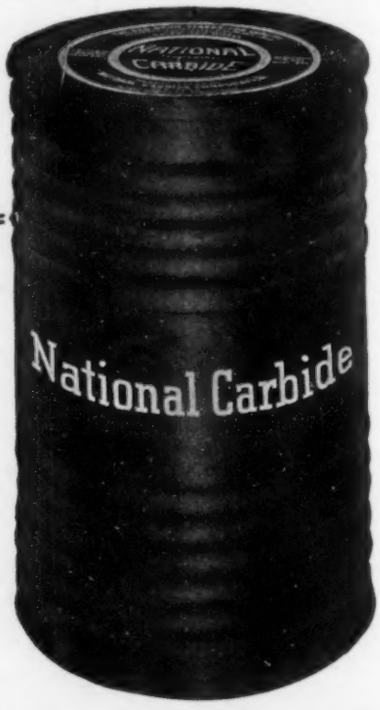

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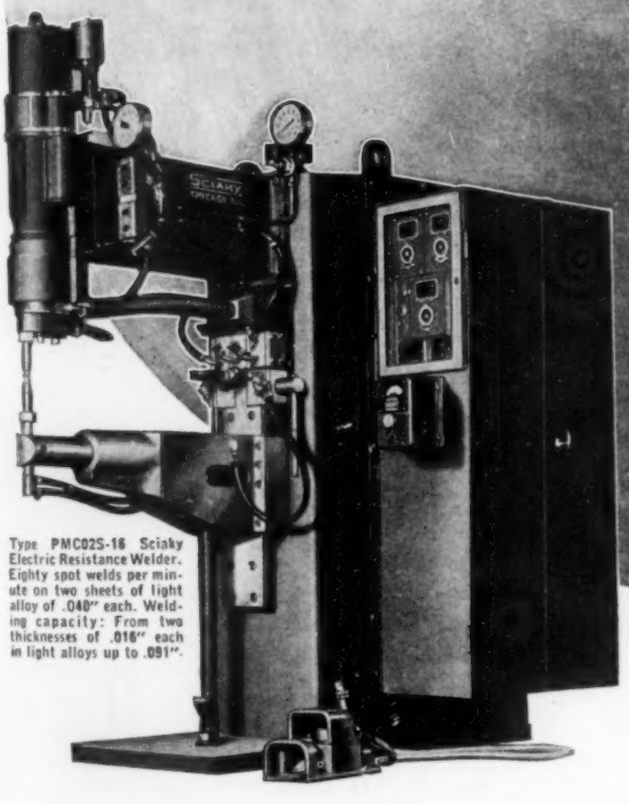

Type PMC02S-16 Sciaky Electric Resistance Welder. Eighty spot welds per minute on two sheets of light alloy of .040" each. Welding capacity: From two thicknesses of .016" each in light alloys up to .091".

ONLY SCIAKY CAN GIVE YOU THESE EXCLUSIVE FEATURES

WRITE FOR DESCRIPTIVE LITERATURE

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UNITED AIRCRAFT CORP.
UNITED STATES ARMY
UNITED STATES NAVY
VULTEE AIRCRAFT, INC.

SCIAKY

PROCESS ELECTRIC RESISTANCE WELDING
STORED ENERGY · VARIABLE PRESSURE
WITH PREHEATING · WITH PRECOMPRESSION

Mr. Tebben has been assigned to the War Production Board as an Industrial Specialist for the Resistance Welding Unit of WPB. His office is in Temporary Building S, Washington, D.C. He is to help solve the problems confronting the Board in that field.

METAL CONGRESS AND EXPOSITION

Hailed as an outstanding example of cooperation for even greater war production in the metal industries, the 24th Annual National Metal Congress and Exposition closed Friday night in Cleveland's Public Auditorium with a total attendance for the week of 46,538 metal experts from the United States, Canada and South America.

"Attendance at the exposition halls was the largest in the history of the event," according to W. H. Eisenman, managing director of the Congress and Exposition, and national secretary of the sponsoring society, the American Society for Metals.

"Total registration at the sessions of the four societies—the American Society for Metals, the Wire Association, the AMERICAN WELDING SOCIETY and the American Institute of Mining & Metallurgy—also hit a new high of 23,285.

"All of these sessions, including the A.S.M. war production meetings, were extremely well attended with as many as 1800 persons attending a single session," Mr. Eisenman said.

While Chicago has been selected for the Congress and Exposition in 1943, definite plans for the event will not be made until the annual meeting of the board of trustees of the American Society for Metals next June.

MEETING BOARD OF DIRECTORS AND EXECUTIVE COMMITTEE, AMERICAN WELDING SOCIETY, SEPTEMBER 25TH

The meeting was called to order at 10:10 A.M. by President Jenks with the following present: C. A. Adams, D. Arnott, H. C. Boardman, R. W. Clark, E. V. David, J. H. Deppeler, O. B. J. Fraser, E. R. Fish, H. O. Hill, F. L. Plummer, E. C Smith, H. S. Smith, A. C. Weigel, W. Spraragen, M. M. Kelly.

Appointment

The appointment of E. D. Hecox on the Educational Committee, made by President Jenks on recommendation of Educational Committee Chairman, was confirmed.

Finances

The Treasurer reported the result of operations for the 11 months ending August 31, 1942. This report indicated a cash betterment of $6400 as compared with last year.

Upon recommendation of the Finance Committee, the sum of $7000 was transferred from the regular operating fund to its permanent reserve fund; this amount being in addition to the 1% of the Society's gross income for the year ending September 30, 1942, already authorized.

Membership Consolidation

A careful study by the Finance Committee revealed that it would be entirely feasible and desirable to eliminate the Operating membership and consolidate that membership with the Associate membership, with annual dues of $10.00. The present By-Laws provide that an Operating Member may remain in that classification for a two-year period.

After deliberation, upon motion duly seconded, it was voted that recommendation of the Finance Committee for the elimination of the Operating membership and for the drafting of an amendment of the By-Laws, making effective the elimination of the Operating membership be referred to the Section Advisory Committee for study, with advice that it is the hope of the Board of Directors that the report of the committee can be rendered in time to bring about an amendment of the By-Laws, if it is deemed desirable, on or before September 1st, the commencement of the new membership year.

Office of Technical Secretary

Upon motion duly seconded, it was voted that resignation of the Technical Secretary be accepted, with deep appreciation for carrying this work for so long a period, and with sincere thanks for his splendid accomplishments while holding the office. It was further voted that Mr. L. M. Dalcher be appointed as Technical Secretary of the Society as of this date.

Future Technical Activities

The Outline of Work Committee Chairman stated that it is planned, because of the limitation of time on the part of men serving on our technical committees, to hold in abeyance any activity that does not contribute to the war effort, in order that the necessary time can be devoted to emergency standards. The Committee however, he reported, stands ready to undertake any standardization work needed, whether directly or indirectly applicable to war production.

Education

There was a feeling, in view of the growth of welding engineers, that it is desirable at this juncture to provide for the establishment of student branches of the Society in universities and colleges, as proposed by the Educational Committee, with the proviso that authority is granted for the establishment of branches only in places where there is a minimum of 15 eligible members. Accordingly, it was voted to request the By-Laws Committee Chairman to appoint a subcommittee consisting of the 3 members of the Educational Committee Subcommittee on student branches with himself as Chairman, to study the matter of student branches as proposed by the Educational Committee, and to prepare a By-Law addition providing for the establishment of student branches of the Society in the universities and colleges where there are a minimum of 15 individuals eligible to membership in the student branch, and to the support of which the Society contribute $25 per annum to meet the incidental expenses incurred in conducting the affairs of the student branch.

The Board of Directors requested the Editor of THE WELDING JOURNAL to confer with the Educational Committee Chairman regarding the preparation of an article for publication in THE WELDING JOURNAL based on information obtained from the questionnaire on requirements for a welding engineer and on any additional information gained by instructors giving welding courses in engineering institutions.

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LESS DOWN TIME
BETTER WELDING
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Spot welding speeds plane production. Seam welding speeds shell production. Flash and butt welding speed tank and jeep production. Mallory tips and holders, wheels and dies speed resistance welding all along the production front. Write today for your free copy of the factual Mallory Resistance Welding Data Book.
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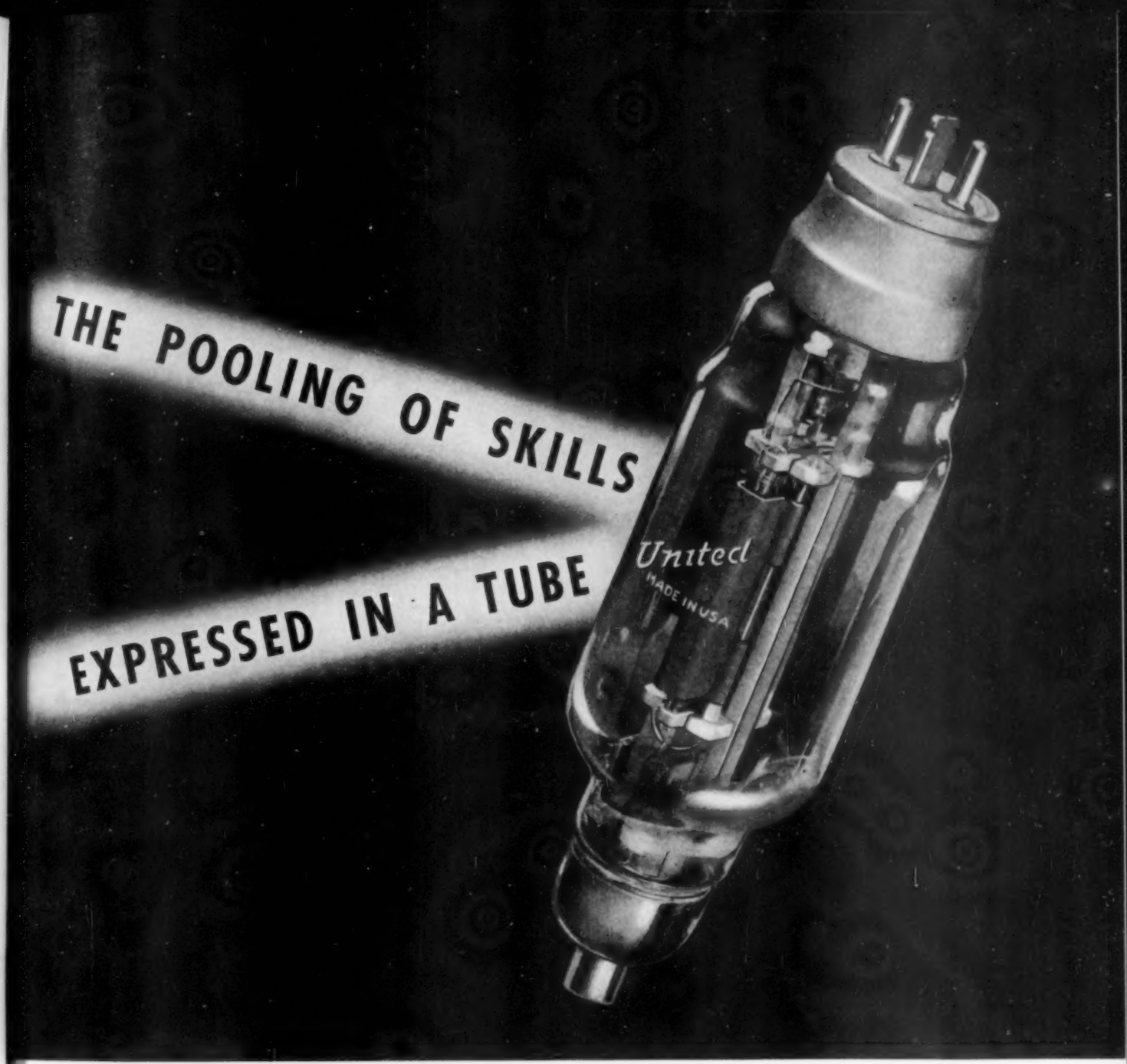


LONG BEFORE "UNITED" symbolized the might of Nations at War, the term possessed a vital significance in electronics.

"United" expressed the vision of a company that undertook to pool, under one roof, the skills of distinguished technicians, engineers and craftsmen, specializing solely in transmitting tubes.

Under the scrutiny of these electronic specialists have come scores of transmitting tubes, built to a degree of precision, hitherto unknown.

Today, the products of "United" are performing flawlessly in key sockets in countless transmitting instruments of our armed forces. Tomorrow—tempered under the fire of war—"United" products of advanced technical design will meet the exacting post-war requirements of Radio Communications, Physiotherapy and Industrial Electronics. Look for the name "United" on each tube.

UNITED ELECTRONICS COMPANY

NEWARK NEW JERSEY

Welding Handbook

It was reported that the sales of the *Handbook* were proceeding at a satisfactory pace and that a sufficient number of copies would be available for the balance of this year and early next year to meet all demands. Later on, it may be necessary to restrict the sales somewhat.

AMERICAN WELDING SOCIETY APPOINTS DALCHER TECHNICAL SECRETARY

The Board of Directors of the AMERICAN WELDING SOCIETY has appointed Mr. L. M. Dalcher to the position of Technical Secretary of the AMERICAN WELDING SOCIETY.

Mr. Dalcher has been with the Society since June 1, 1939, during which period he served as Assistant Technical Secretary and as Secretary of most of the technical committees of the Society.

This promotion will enable Mr. W. Spraragen, the present Technical Secretary, to devote his energies to his work as Editor and Business Manager of THE WELDING JOURNAL and Executive Secretary of the Welding Research Committee.

Mr. Dalcher received his major engineering education at Brooklyn Polytechnic Institute. This training has been supplemented by practical experience in the metallurgical laboratories of the International Nickel Company and the Crucible Steel Company.

M. M. KELLY, *Secretary*

DETROIT MEETING

The AMERICAN WELDING SOCIETY and the Detroit Section are indebted to the *Iron Age* for the excellent review of the activities of the Detroit Section which appeared in the September 17th issue of *Iron Age*. The account of the meeting shows how the Detroit Section is serving the war industries in a variety of ways.

COMMUNICATION TO THE EDITOR

WAR PRODUCTION BOARD
Oct. 9, 1942

Mr. W. Spraragen
AMERICAN WELDING SOCEITY
New York City, New York
DEAR SIR:

On your recent trip to Washington you asked us to tell you what the technical group of the AMERICAN WELDING SOCIETY could do to help in our work here at the War Production Board. You can help us considerably by circulating the following recommendations for us. These recommendations are all directed toward the conservation of critical materials.

1. All electrodes shall be completely burned to the end of the coating and operators should make every effort to segregate short sections of electrodes so that they may be reused until they have been completely burned. Several Maritime Commission contractors who operate training schools accumulate electrodes that are not completely burned the first time the arc is struck and use these partially burned electrodes in their training programs. This allows the operator in the yard to use full-length electrodes at all times and also gives trainees a shorter and easier electrode to handle for his training routine.

2. The largest diameter electrode applicable to any given work shall be used. This will allow for more rapid deposition of metal and will also help increase the total tonnage of electrodes produced since the manufacturers of electrodes can produce the same number of electrodes per unit time regardless of the diameter. Care should be taken in making this recommendation. The user should be cautioned not to go overboard and use larger, diameter electrodes if it is going to result in the deposition of more metal than is needed to make an efficient joint. There are enough engineering data available through the AMERICAN WELDING SOCIETY publications and manufacturers' literature to guide any user in maintaining correct practice in his shop.

3. Users should be careful to store electrodes in dry places to avoid the possibility of damage to the coating due to the pick-up of moisture. It is economical for users of large quantities to keep electrodes in a uniformly heated storage space. It is also advisable to only check out to an operator enough electrodes to complete his day's work.

4. No electrodes shall be bent if such bending will damage the coating or make it impossible to burn the electrode down to the end of the coating. The bending of electrodes is habit with many operators and has no real definite advantage except occasionally when it is necessary to bend an electrode to reach an inaccessible place. There are some types of electrodes available that can be slightly bent without serious damage to the coating and if there is work to be done that requires the bending of electrodes those grades that can be bent without damage to the coating should be chosen for use.

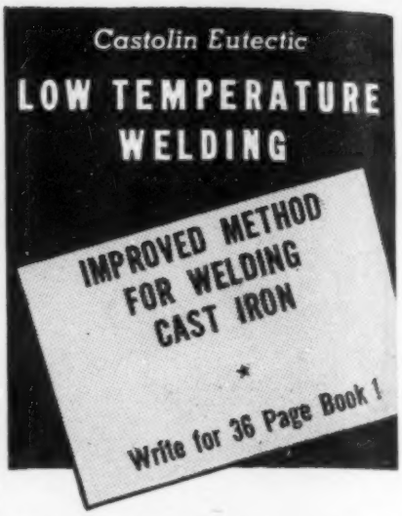
5. Users should purchase only standard sizes and grades of electrodes and we recommend the following standard lengths:
$^3/_{32}$ in.—9 in. end grip, or 18 in. center grip
$^1/_8$, $^5/_{32}$, $^3/_{16}$ in.—14 in. end grip
$^1/_4$ in.—14 in. and 18 in.
$^5/_{16}$ and $^3/_8$ in.—18 in. and 24 in.

6. We recommend that all schools train operators to weld with $^3/_{16}$-in. and $^1/_4$-in. diameter electrodes and that no operator be certified until he can satisfactorily deposit metal in the vertical position with $^3/_{16}$-in. diameter electrodes.

7. Arc-welding machines should be purchased so that they will be used at their top rating. Too many 400- and 600-ampere machines are now being used with $^1/_8$-in. and $^5/_{32}$-in. diameter electrodes. Smaller machines could be utilized on this work and the manufacture of the smaller machines requires far less weight of critical copper and iron.

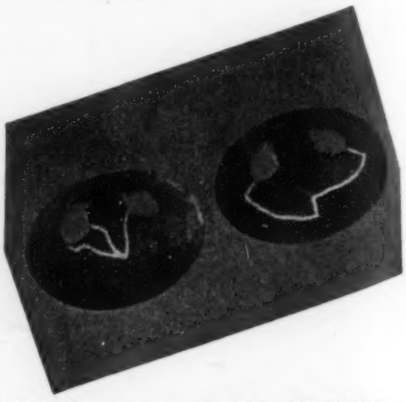
8. Transformer type arc-welding machines should be employed wherever the application warrants.

9. There is a great deal of accessible but idle gas-cutting and welding apparatus in existence and every effort should be made to put this idle equipment into use before requisitions for new equipment are initiated.



War plants the country over rely on Castolin Eutectic Alloy #14* (for gas welding) and Castolin Eutectic Alloy #24B* (AC-DC metallic arc) for easy, reliable welding and reclaiming of broken, cracked, worn, or defective castings. These new low temperature welding alloys give a completely machinable, color matching weld—free from stresses and distortion.

Use Castolin Eutectic Low Temperature welding alloys #14* and #24B* in place of "hard-to-get" bronze welding rods. Castolin Eutectic Alloys #14* and #24B* contain no scarce metals . . . . available with priority A9.



Cast Iron covers salvaged with Castolin Eutectic Low Temperature Alloys.

CHECK THESE ADVANTAGES:

- *High strength*
- *Matching color*
- *Less stresses*
- *Less warping*
- *Less preheating*
- *Greater economy*

*Patented

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EUTECTIC WELDING ALLOYS CO.
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We're Welding a White-Hot Welcome for Aggressors . . .
Cue for You to Join
THE AMERICAN WELDING SOCIETY

SHELLS seam-welded, 300 an hour by one man and one machine . . . warplane output speeded up 30% by spot welding . . . freighter production 37.5% faster, thanks to arc welding . . . so go the averages, as America has gone to war.

You'd probably like to meet the men who are helping to hang new production records "on the hook" every few days, in industries all over the country. One of the best ways to meet them is to join the American Welding Society.

The Society's meetings, research program, and the pages of its publications have attracted key men in practically every field . . . engineers, executives, purchasing agents, foremen, welders, inspectors, professors, students, research workers, draftsmen, designers.

Here's what the Society and its 5500 members offer you in 1942:

1. An opportunity to meet and talk with leaders of the welding industry at monthly Section meetings, at the Annual Meeting and at other regional and national meetings.
2. A key to new ideas and the latest progress in the art. Code service for Sustaining Members, with up-to-date bulletins.
3. A chance to take an active part in developing better welding techniques and new applications. Research conducted under the auspices of the Welding Research Committee.
4. Subscription, with your Membership, to *The Welding Journal* . . . authoritative monthly information on welding practice, applications, codes and standards. Bound volumes each year to Sustaining Members.
5. *The Welding Handbook*, also free to Sustaining and full Members and at reduced price to Associate, Operating and Student Members, costing outsiders $6 in the United States and $6.50 elsewhere.
6. Membership Certificate; Membership Emblem (available at nominal cost).
7. *Year Book* telling "who's who" in welding.

COST: Sustaining Membership, $100; Membership, $15; Associate Membership, $10; Operating Membership, $5; Student Membership, $2.50 a year.

The American Welding Society provides you who are interested in welding with a growing fund of data and ideas . . . any one of which may be worth many times the cost of many years' membership to you. Please write me for a free copy of our informative booklet on the Society.

J. D. TEBBEN, Chairman Membership Committee
THE AMERICAN WELDING SOCIETY
33 West Thirty-Ninth Street
New York, N. Y.

★

10. Welding and cutting tips should not be discarded but should be repaired and put back into service. Any cutting tips that cannot be put back into service should be returned to the manufacturer so that the scrap can be utilized to the greatest advantage.

11. Cutting and welding operators should be careful in handling their tips and blowpipes and make an attempt to get out of the habit of using this apparatus as a hammer or other accessory tool.

12. Reduce to an absolute minimum the number of the repair parts carried in stock.

13. No special items should be manufactured when there is a standard unit that could possibly perform the work to be done.

14. Both analysis and design of resistance welding electrodes should be definitely standardized.

15. Resistance welding transformer specifications set up by R.W.M.A. should be universally adopted.

Very truly yours,

K. W. OSTROM, *Chief, Welding Section, General Industrial Equipment Branch*

WELDING OF HIGH PRESSURE PIPING

In the paper presented by H. J. Irrgang of the W. K. Mitchell & Company, Inc., Philadelphia, Pa., published in the September issue of THE WELDING JOURNAL, the name of the company was inadvertently omitted. It is as shown above.

ARMY-NAVY PRODUCTION AWARDS

Quite a few companies affiliated with the AMERICAN WELDING SOCIETY have already won the Army-Navy Production Award for high achievement in the production of war equipment. A recent addition to this honor list is the Arcos Corporation of Philadelphia. The ceremonies and presentation were held on September 28, 1942.

Significance of Award

In 1906 the Navy instituted in the Fleet an award for excellence which has been known ever since as the Navy "E." First awarded for excellence in gunnery, this was later extended to include outstanding performance in engineering and communication. An honor not easily won nor lightly bestowed, it became and has remained a matter of deep pride to the men of the Service who receive it.

When the rising tide of war in Europe placed a premium on the production of war equipment, the Navy "E" award was extended to embrace those plants and organizations which showed excellence in producing ships, weapons and equipment for the Navy.

Then came Pearl Harbor—and with it a demand for war production such as the world has never known . . . an awareness that our fighting forces and the men and women of American industry are partners in the great struggle for human freedom . . . and on the part of all Americans a grim and enduring resolve to work and fight together until victory in that struggle is final and complete.

From that high resolve was born the Army-Navy Production Award—which stands today as our fighting forces' joint recognition of exceptional performance on the production front . . . of the determined, persevering, unbeatable American spirit which can be satisfied only by achieving today what yesterday seemed impossible.

THE JAMES F. LINCOLN ARC WELDING FOUNDATION AND ITS IMPORTANCE TO WAR AND POSTWAR EFFORTS

The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, for 2½ yrs. has been carrying on its second industrial study on arc welding, for which 408 awards totaling $200,000 were announced.

Results of the study show the war industries have only begun to gain the benefits of modern arc welding; that further application of the welding process will slash hundreds of millions of dollars off the United Nations' war bill and will cut by 30% the time required to produce ships and planes.

Arc welding will turn out vitally needed naval and military equipment which is more combat-proof and at the same time will save an average of 300 lb. out of every ton of steel going into war production.

Papers were submitted to the Lincoln Foundation study from 46 of the 48 states, by engineers, designers, architects, maintenance men and executives throughout the industrial field.

Altogether, 408 awards were made to 458 recipients, the difference covering joint authorship. One divisional award of $150 was vacated and two additional awards, one of $100 and one of $50, paid with this money to fill out the $200,000, in accordance with the rules. Awards embraced 46 divisions of participation, which encompassed the entire industrial field.

The great mass of important new welding data contained in the papers will be made available as soon as possible for the benefit of war industries—in the form of articles in trade publications and other magazines and eventually in book form.

This was done at the conclusion of the last foundation study in 1937–38, and resulted in the dissemination of information which became vital in the nation's war production, utilizing welding.

The Foundation was founded in 1936 in honor of James F. Lincoln, president of the Lincoln Electric Co., Cleveland, by the company's board of directors.

Dr. E. E. Dreese, head of the department of Electrical Engineering at Ohio State University, chairman of the Foundation Jury of Award, is also chairman of the Foundation's board of trustees, composed of W. B. Stewart of McKeehan, Merrick, Arter and Stewart, Cleveland; H. R. Harris, vice-president of the Central National Bank, Cleveland; A. F. Davis and Ed C. Powers of Cleveland, secretary and assistant secretary, respectively.

ADDITIONAL ARMY-NAVY "E" AWARD WINNERS

Tube Turns, of Louisville, recently won the distinction of being the first war industry plant in the state of Kentucky to receive the coveted Army and Navy "E" flag for outstanding production efficiency.

National, state and local industrial and military leaders attended the brief, colorful ceremonies at the plant on September 18th.

Buy "Proven Fluxes" with Years of Guaranteed Satisfaction behind them

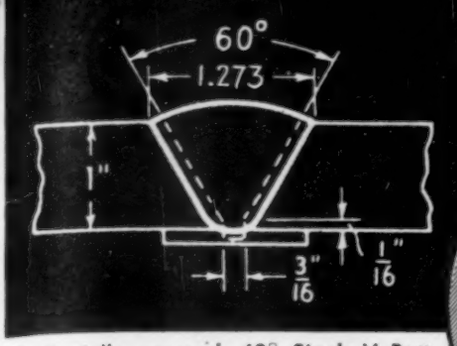
The Trade-Name is "ANTI-BORAX"

Ask for Them ***Unequalled for Quality***

A Flux for every metal: Cast Iron Welding Flux No. 1; Brazing Flux No. 2; Braz-Cast Flux No. 4, for bronze-welding cast iron; "ABC" Aluminum Flux No. 8 for sheet Aluminum and all alloys of Aluminum; Stainless Steel Flux No. 9; Silver Solder Brazing Flux No. 10; "Anti-Borax" Tinning Compound No. 11.

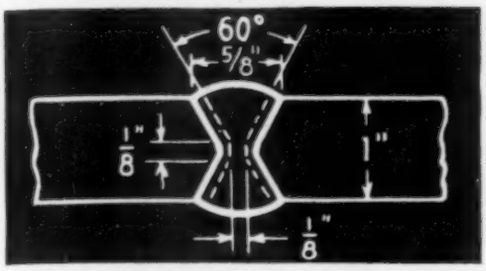
ANTI-BORAX COMPOUND COMPANY
Fort Wayne, Indiana

SELECTION OF PROPER JOINT HELPS CONSERVE ELECTRODES

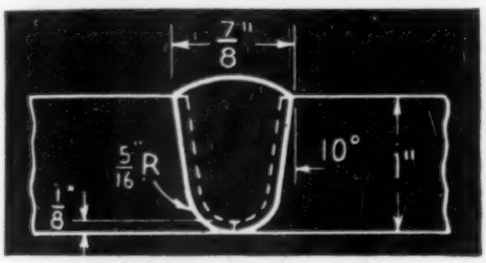


1. Partially grooved, 60° Single-V Butt joint with backing strip
Averages 4.56 lbs. electrodes per linear foot.

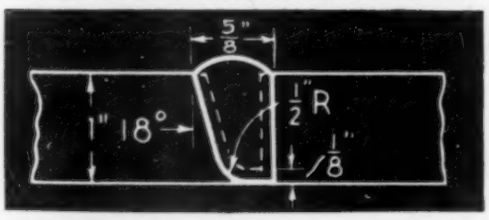
Same joint, 45° included angle and 3/8" gap
Averages 3.16 lbs. electrodes per linear foot.



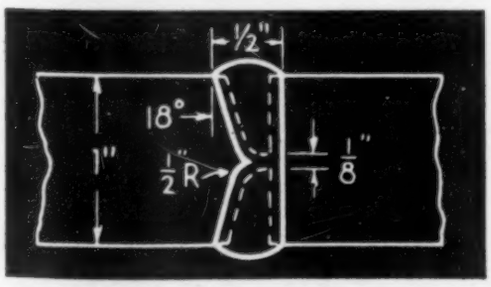
2. Partially grooved 60° Double-V Butt Joint
Averages 3.02 lbs. electrodes per linear foot.



3. Single-U Butt Joint
Averages 3.85 lbs. electrodes per linear foot.



4. Single-J Butt Joint
Averages 2.70 lbs. electrodes per linear foot.



5. Double-J Butt Joint
Averages 2.20 lbs. electrodes per linear foot.

With the critical shortage in electrodes, it is of vital importance that careful thought be given to employing joint designs that require minimum amounts of weld metal, bearing in mind, of course, the requirements of the job and all of the many variable factors, such as joint preparation, cleaning time, and welding procedure.

Other things being equal, it may be possible to save a substantial quantity of electrodes by substituting one joint for another, without sacrificing necessary strength or adding to labor costs.

For instance, in butt welding one inch plate, original specifications might call for a partially grooved 60° Single-V Butt Joint (Fig. 1), requiring an average of 4.56 pounds of electrodes per foot of weld. Under certain circumstances, a Double-V Butt Joint (Fig. 2) would be just as practical and this joint would require only 3.02 pounds per foot, making a saving of more than 33% in pounds of electrodes consumed.

A study of the accompanying sketches shows other comparisons of the amounts of electrodes needed for various types of joints on butt welds.

We have prepared a complete set of charts showing the pounds of Murex electrodes required per linear foot of weld in common types of joints. Copies will be sent on request.

METAL & THERMIT CORPORATION
120 BROADWAY, NEW YORK, N. Y.

Specialists in welding for nearly 40 years. Manufacturers of Murex Electrodes for arc welding and of Thermit for repair and fabrication of heavy parts.

* Note: All of the above are for welding one inch plate. Figures are based on average conditions and are given only to illustrate the principle involved.

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MUREX
ARC WELDING ELECTRODES

The presentation of the Army-Navy "E" Award for excellence in production went to the Wellman Engineering Co., Cleveland, Ohio, August 12.

The Army-Navy Production Award to the employees of the Independent Pneumatic Tool Co., Aurora, Ill., was made on October 8th.

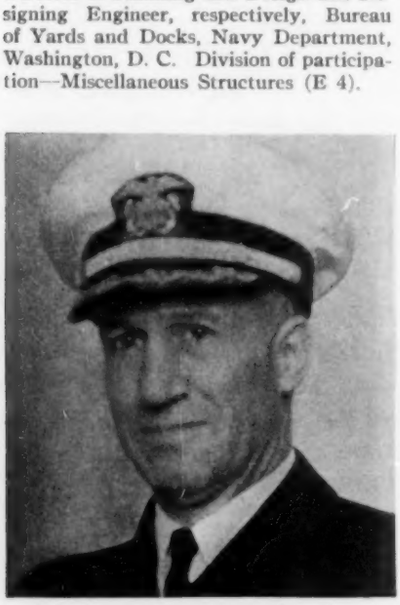
Presentation Ceremonies for the Army-Navy Production Award to Independent Pneumatic Tool Company, Aurora, Illinois, were also held on October 8th.

LAKE LOUISE HOTEL

In the September 1942 JOURNAL there was shown the all-welded Lake Louise Hotel built by the LeTourneau Co. of Georgia. This hotel is located near Toccoa, Ga., instead of Canada as indicated.

GRAND AWARDS IN $200,000 INDUSTRIAL PROGRESS PROGRAM OF THE JAMES F. LINCOLN ARC WELDING FOUNDATION

First Prize, $13,700—Captain C. A. Trexel, (CEC) U.S.N., and A. Amirikian, Director of Planning and Design and Designing Engineer, respectively, Bureau of Yards and Docks, Navy Department, Washington, D. C. Division of participation—Miscellaneous Structures (E 4).



Captain C. A. Trexel

Subject Matter: Caissons for naval dry docks. Former methods of calculation and design are discussed and the new elastic slab method is presented which is more applicable to welded construction.

A. Amirikian

Designs were prepared for two large caissons of riveted construction. It was then decided to prepare alternate designs of all-welded construction. These were submitted for bids. Eight contractors participated in the bidding. The low bid for the two caissons for the welded design was $108,030 less than that for the riveted design, amounting to 25.0% in cost. As a result, the Navy department has let a number of other contracts for similar welded structures.

Net savings for caissons built and under contract, $1,652,000. Savings on projected construction in the immediate future, $3,540,000. Savings in weight (projects built), 4200 tons and (caissons projected), 9000 tons.

Second Prize, $11,200—John L. Miller, Chief Metallurgist, Gun-Mount Div., Firestone Tire and Rubber Co., Akron, Ohio. Division of participation—Industry Machinery, Not Otherwise Classified (K 10).

Subject Matter: This paper on the redesign for welding of the 40 mm. Bofors anti-aircraft gun describes with great care how various parts were changed from riveted to welded design. The chassis and outrigger supports were redesigned with high-strength low-alloy steels and although only 30% more weight was added, strength was increased 50%. Cost per chassis was $76.80 less than riveted construction.

The top carriage which carries the gun was redesigned for welding with a net saving of 17 lb. as compared with riveted construction of equal strength. Appearance was improved and cost was reduced $10.37, excluding overhead or profit. The axles used in the foreign design were estimated at $110 each when made from solid bars by forging. Design, involving tubes and cast steel ends joined by welding, saved about $68 per axle.

A number of other smaller parts were also redesigned to be welded. The total saving with 35,000 units is estimated at $6,000,000.

While cost is secondary in a military program, the important factor here is the increase in production and the improvement in the performance of the final product.

Third Prize, $8,700—H. Thomasson, Welding Engineer, Canadian Westinghouse Company Ltd., Hamilton, Ont., Canada. Division of participation—Functional Machinery, Electrical (J 3).

Subject Matter: A new type of large mercury-arc rectifier, called ignitron, has been built which requires extremely high vacuum. Arc-welded construction was used as it seemed not only the best but often the only way to secure the required tightness. On a number of items, an average of 47% was saved in cost by using arc welding instead of an alternative construction. This amounted to $63,000 per year for the company, which, at the same rate, would be $166,000 for the industry.

The main advantages of the new type rectifier are that it has greater reliability and about 1.8% higher efficiency than other types of rectifiers. The new type rectifiers which have been built are estimated to save power valued at $670,000 per year. A portion of this saving is due to arc welding since without it, there is doubt whether the new type of rectifier could be successfully built. That the price of the new rectifiers is competitive is indicated by the large number of orders on hand.

Judging the papers in the $200,000 Progress Award Program was a 16-man Jury of Award, comprising Dr. Dreese, chairman; Assistant Professor R. W. Ahlquist, Electrical Engineering Department, Iowa State College; Associate Professor Paul Andersen, Civil Engineering Department, University of Minnesota; Professor Allison Butts, Electrometallurgy Department, Lehigh University; Professor R. L. Dowdell, Metallography Department, University of Minnesota; R. G. Dukes, dean of Graduate School, Purdue University; Professor Herbert B. Dwight, Electrical Engineering Department, Massachusetts Institute of Technology; Assistant Professor Fulton Holtby, Foundry Practice, University of Minnesota; Professor C. A. Koepke, Mechanical Engineering Department, University of Minnesota; Professor Arthur F. Macconochie, Mechanical Engineering Department, University of Virginia; O. W. Muckenhirn, instructor of electrical engineering, University of Minnesota; C. T. Morris, head of Civil Engineering, Ohio State University; J. B. Taylor, head of Department of Accounting, Ohio State University; L. F. Van Hagan, chairman

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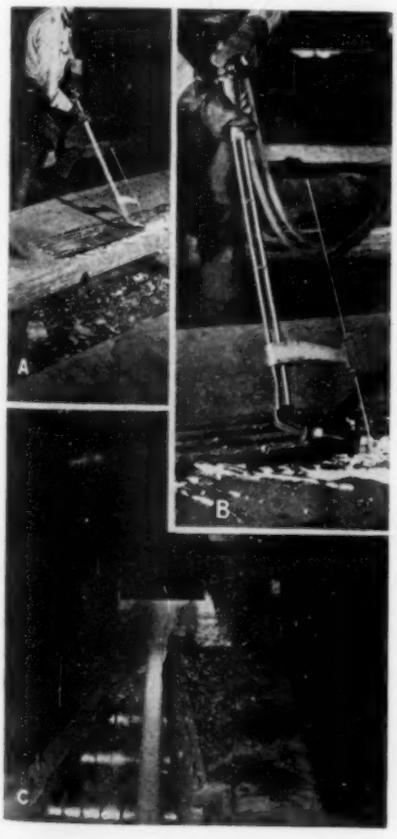
of Civil Engineering Department, University of Wisconsin; Professor Chilton A. Wright, Civil Engineering Department, Polytechnic Institute of Brooklyn.

BOUND VOLUME JOURNAL

The AMERICAN WELDING SOCIETY has made arrangements for members who wish to have their Journals for 1942 bound in attractive, imitation black leather covers, to do so by sending copies of the twelve issues to Russell-Rutter Company, Thirty-Third Street and Eighth Avenue, New York, N. Y., Att. Mr. Russell Lauben, Jr. A special reduced rate has been arranged at $2.50 per volume providing the issues of the JOURNAL are sent to the binder on or before Jan. 15, 1943. Journals received after this date cannot be bound at this reduced rate. The bill for the binding and return postage will be sent direct from the Society's office.

TWO METHODS OF STEEL CONDITIONING

Surface imperfections in steel billets and slabs are quickly removed by the oxy-acetylene flame. This operation, known as steel conditioning or scarfing, can be accomplished manually after the steel has cooled, as shown in Photos *A* and *B*, or by a conditioning machine set into the rolling-mill line which scarfs the steel while it is still hot and without interrupting the rolling operation, as shown in Photo *C*. The machine in Photo *C* is removing $^1/_{16}$ in. of steel from all four sides simultaneously of an 8-in. square billet at a speed of 125 ft. per minute.



MEMBERS OF AMERICAN WELDING SOCIETY RECEIVING AWARDS IN $200,000 PROGRESS PROGRAM OF THE JAMES F. LINCOLN ARC WELDING FOUNDATION

$13,700 Captain C. A. Trexel (CEC), U.S.N., Director of Planning and Design, and A. Amirikian, Designing Engineer, Bureau of Yards and Docks, Navy Department, Washington, D. C. Division of participation—Structural, (E 4).

$3,700 G. J. Storatz, Assistant Chief Engineer, The Heil Company, Milwaukee, Wisc. Division of participation—Automotive, (A 4).

$3,700 A. M. Unger, Plant Engineer, Pullman-Standard Car Manufacturing Company, Chicago, Ill. Division of participation—Railroad, (C 3).

$3,700 Stanley A. Midnight, American Ship Building Company, Cleveland, O. Division of participation—Watercraft, (D 1).

$3,700 J. O. Jackson, Chief Engineer, Pittsburgh Des Moines Steel Company, Pittsburgh, Pa. Division of participation—Containers, (H 1).

$2,700 H. Malcolm Priest, Engineer, U. S. Steel Corporation Subsidiaries, Pittsburgh, Pa. Division of participation—Railroad, (C3)

$2,500 George F. Wolfe, Chief Plant Engineer, Dravo Corporation, Pittsburgh, Pa. Division of participation—Welderies, (I 2).

$1,700 John H. Hruska, Chief Inspector, Electro-Motive Division, General Motors, LaGrange, Ill. Division of participation—Railroad, (C 1).

$1,500 James M. Pool, Owner, Louisville Welding Works, Louisville, Ky. Division of participation—Commercial Welding, (G 1).

$1,500 Walter J. Brooking, Director of Testing and Research, R. G. LeTourneau, Incorporated, Peoria, Ill. Division of participation—Industry Machinery, (K 2).

$1,250 W. S. Evans, Materials and Process Engineer, Curtiss-Wright Corporation, Airplane Division, Lambert Field, St. Louis, Mo. Division of participation—Aircraft, (B 2).

$700 John B. Austin, Welding Engineer, The Republic Welding and Flame Cutting Company, Cleveland, O. Division of participation—Welderies, (I 1).

$700 John F. Dillion, Jr., Welding Engineer, LeTourneau Company of Georgia, Tournapull Station, Toccoa, Ga. Division of participation—Automotive, (A 1).

$700 Van Rensselaer P. Saxe, Consulting Engineer, Baltimore, Md. Division of participation—Structural, (E 1).

$700 Richard W. Stanley, Design Engineer, American Viscose Corporation, Marcus Hook, Pa. Division of participation—Industry Machinery, (K 8).

$500 C. Merrill Barber, Consulting Structural Engineer, Cleveland, O. Division of participation—Structural, (E 1).

$500 Paul Ffield, Materials Engineer, Bethlehem Steel Company, Quincy, Mass. Division of participation—Functional Machinery, (J 4).

$250 Edgar Brooker, Ordnance Engineer, Tank and Combat Vehicle Division, Industrial Service, Ordnance Department, U. S. Army, Washington, D. C. Division of participation—Automotive, (A 2).

$250 Herman C. Frentzel, Chief Engineer, and Arnold Meyer, Engineer of Tank Design, The Heil Company, Milwaukee, Wisc. Division of participation—Containers, (H 1).

$250 Walter E. Davis, Maintenance Superintendent, City of Cleveland, Department of Public Utilities, Division of Transit, Cleveland, O. Division of participation—Maintenance, (L 2).

$250 Gilbert L. Yetter, Engineer, Bureau of Reclamation, Department of Interior, U. S., (Toyon), Redding, Calif. Division of participation—Containers, (H 2).

$250 R. W. De Vore, Structural Engineer, General Engineering Department, The Commonwealth and Southern Corporation, Jackson, Mich. Division of participation—Structural, (E 4).

$150 Charles Apacki, Maintenance Welding and Construction Foreman, R. G. LeTourneau, Incorporated, Peoria, Ill. Division of participation—Functional Machinery, (J 10).

$150 William DeGray, Foreman, Arc Welding Department, Bell Aircraft Corporation, Buffalo, N. Y. Division of participation—Aircraft, (B 2).

$150 Edward G. Biederman, Fisher Tank Division, Flint, Mich. Division of participation—Automotive, (A 2).

$150 John E. Taylerson, Engineering Assistant, Federal Shipbuilding and Dry Dock Company, Kearny, N. J. Division of participation—Watercraft, (D 1).

$150 Eugene A. Balsley, Chicago, Ill. Division of participation—Industry Machinery, (K 2).

$100 C. Harold Louree, Designing Engineer, Patterson Steel Company, Tulsa, Okla. Division of participation—Structural, (E 1).

$100 Harold Nagin, Chief Engineer, Reliance Steel Products Com-

pany, McKeesport, Pa. Division of participation—Structural, (E 2).

$100 W. H. Rice, Assistant Professor in Welding, Oklahoma Agricultural and Mechanical College, Stillwater, Okla. Division of participation—Furniture and Fixtures, (F 2).

$100 Fred L. Plummer, Research Engineer, Hammond Iron Works, Warren, Pa. Division of participation—Containers, (H1).

$100 Rudolph Kraus, Welding Engineer, Stacey Brothers Gas Construction Company, Cincinnati, O. Division of participation—Containers, (H 1).

$100 Harry A. Erickson, Consultant, Mechanical Engineer, Baltimore, Md. Division of participation—Containers, (H 2).

$100 Ray B. Foster, Instructor of Welding, Washburne Trade School, Chicago, Ill. Division of participation—Containers, (H 2)

$100 Louis H. Burr, Works Manager, The Austin Company, Fabricating Division, Euclid, O. Division of participation—Welderies, (I 2).

$100 William E. Begor, Welding Engineer, and David S. McLellan, Welding Inspector, North Carolina Shipbuilding Company, Wilmington, N. C. Division of participation—Welderies, (I 2).

$100 Walter E. Klauberg, Design Engineer, Wyatt Metal and Boiler Works, Houston, Tex. Division of participation—Functional Machinery, (J 2).

$100 Horace Jackson, Plant Superintendent, Thompson Pipe and Steel Company, Denver, Colo. Division of participation—Functional Machinery, (J 9).

$100 John H. Kincaid, Chief Engineer, Wellman Engineering Company, Cleveland, O. Division of participation—Functional Machinery, (J 10).

$100 L. V. Hile, Welding Foreman, Phillips Petroleum Company, Borger Refinery, Phillips, Tex. Division of participation—Maintenance, (L 1).

$100 R. C. Fitzgerald, Welding Engineer, Consolidated Gas Electric Light and Power Company, Baltimore, Md. Division of participation—Maintenance, (L 1).

$100 J. J. Laudig, Research Engineer, Delaware Lackawanna and Western Railroad Company, Scranton, Pa. Division of participation—Maintenance, (L 1).

$100 E. W. Taylor, Vice-President, Industrial Brownhoist Corporation, Bay City, Mich. Division of participation—Functional Machinery, (J 5).

$100 Felix S. Hales, Bridge Engineer, New York, Chicago and St. Louis Railroad, Cleveland, O. Division of participation—Maintenance, (L 2).

WAR PRODUCTION BOARD
M-233

PART 3082—GAS CYLINDERS

[General Preference Order M-233]

The fulfillment of requirements for the defense of the United States has created a shortage in the supply of gas cylinders for defense, for private account and for export; and the following order is deemed necessary and appropriate in the public interest and to promote the national defense:

§ 3082.1 (*General Preference Order M-233*)—(*a*) *Definitions.* (1) "Gas cylinder" means any portable steel container other than a steel drum, which has a capacity of less than one ton, and which is suitable for shipping gas charged at high or low pressure.

(2) "Gas cylinder forging" means any steel forging to be used in the manufacture of a gas cylinder.

(3) "Producer" means any person engaged in the manufacture of gas cylinders or gas cylinder forgings.

(*b*) *Restrictions upon manufacture and delivery of gas cylinders and gas cylinder forgings.* On and after September 30, 1942, and prior to January 1, 1943, all producers shall observe any specific direction by the Director General for Operations, pertaining to the manufacture and delivery of gas cylinders and gas cylinder forgings. On and after January 1, 1943, no producer shall manufacture or deliver any gas cylinder or gas cylinder forging except as specifically directed by the Director General for Operations. Such directions will be made primarily to insure satisfaction of all defense requirements of the United States, both direct and indirect, and they may be made in the discretion of the Director General for Operations without regard to any previous ratings assigned to particular contracts or purchase orders.

(*c*) *Reports.* On or before October 25, 1942, each producer shall submit to Containers Branch, War Production Board, Washington, D. C., Ref: M-233, upon Form PD-662, data relative to the manufacture and delivery of gas cylinders and gas cylinder forgings during the calendar month beginning January 1, 1943. Similarly, on or before the 25th day of each calendar month after October 25, 1942, each producer shall file Form PD-622.

(*d*) *Miscellaneous provisions*—(1) *Applicability of priorities regulations.* Except to the extent that a schedule for the manufacture and delivery of gas cylinders or gas cylinder forgings is altered by any direction of the Director General for Operations, this order and all transactions affected thereby are subject to all applicable provisions of the Priorities Regulations of the War Production Board, as amended from time to time.

(2) *Communications.* All reports required to be filled hereunder and all communications concerning this order shall, unless otherwise directed, be addressed to: War Production Board, Containers Branch, Washington, D. C., Ref: M-233.

(3) *Violations.* Any person who wilfully violates any provision of this order, or who, in connection with this order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States is guilty of a crime and, upon conviction, may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priority control and may be deprived of priorities assistance.

(P.D. Reg. 1, as amended, 6 F.R. 6680; W.P.B. Reg. 1, 7 F.R. 561; E.O. 9024, 7 F.R. 329; E.O. 9040, 7 F.R. 527; E.O. 9125, 7 F.R. 2719; sec. 2 (*a*), Pub. Law 671, 76th Cong., as amended by Pub. Laws 89 and 507, 77th Cong.)

Issued this 30th day of September 1942.

ERNEST KANZLER,
Director General for Operations.

OBITUARY

E. W. P. Smith

Services for Edward W. P. Smith, 56-year-old consulting engineer for the Lincoln Electric Co. and a nationally known authority on arc welding, were held Tuesday morning, September 22, in Cleveland.

His death came as a shock to his associates, as he had appeared to be in good health.

A veteran of more than 20 years' service with the Lincoln company, Mr. Smith had traveled extensively in the last year in the interests of the war production program.

Visiting many war-industry centers, he had been conducting welding courses and giving lectures on the latest techniques in welding. He gave advice to many war concerns utilizing welding in the construction of war equipment.

Mr. Smith was born in Cleveland and was graduated from Colorado College, Colorado Springs, Colo., with a degree in electrical engineering. Before joining Lincoln Electric as a tester he had worked in the electrical inspection department of the city of Cleveland and for the Westinghouse Electric & Manufacturing Co. in Pittsburgh.

E. W. P. Smith

The welding expert gave special courses at the Lincoln plant each month on designing for welding. He developed several original methods of demonstrating the stresses in metals.

In addition to membership in the A.W.S., Mr. Smith belonged to the American Society for Metals, the American Society of Mechanical Engineers, the American Society of Testing Materials and the Cleveland Engineering Society. He was co-author with A. F. Davis, vice-president and secretary of the Lincoln Electric Co., of the Procedure Handbook of Arc Welding Design and Practice, a standard reference guide in the arc-welding field. He had also contributed hundreds of articles to the trade and technical magazines giving important design and procedure information on the application of the arc welding process.

NOTED METALLURGIST TO DIRECT BATTELLE'S FUNDAMENTAL RESEARCH ACTIVITIES

Charles G. Maier, noted research metallurgist, for nearly twenty years associated with the U. S. Bureau of Mines, has been named to the supervisory staff of Battelle Memorial Institute, Columbus, Ohio, one of the country's largest industrial research foundations. According to Clyde E. Williams, Battelle director, Mr. Maier will direct and correlate an enlarged program of fundamental research and will serve as adviser and consultant to the Institute's war research for the Government and industry.

A.S.M.E. OFFICERS

Harold V. Coes, vice-president of Ford, Bacon & Davis, Inc., New York, was elected by a letter ballot of the 16,250 members of The American Society of Mechanical Engineers to be president of the Society during 1943, according to the official announcement of election results by C. E. Davies, secretary of the Society.

Vice-presidents elected at the same time to serve two-year terms on the Council of the A.S.M.E. were Joseph W. Eshelman, president, Eshelman & Potter, Birmingham, Ala.; Thomas E. Purcell, general superintendent of power stations of the Duquesne Light Company, Pittsburgh, Pa.; Guy T. Shoemaker, vice-president, Kansas City Light & Power Company, Kansas City, Mo.; Walter J. Wohlenberg, professor of mechanical engineering, Yale University, New Haven, Conn.

Managers of the Society elected to serve on Council for three-year terms include Roscoe W. Morton, professor of mechanical engineering and head of the department, University of Tennessee, Knoxville, Tenn.; Alexander R. Stevenson, Jr., staff assistant to vice-president, General Electric Co., Schenectady, N. Y.; and Albert E. White, director engineering research, University of Michigan, Ann Arbor, Mich.

The new officers will be installed during the 63rd Annual Meeting of the Society to be held in New York, N. Y., at the Hotel Astor, November 30–December 4, 1942.

METAL & THERMIT CORP. PROMOTIONS

Charles D. Young, formerly district manager of Metal & Thermit Corporation's Chicago office, has been appointed Sales Manager of the Welding Division of the Corporation. His headquarters will be at 120 Broadway, New York.

Mr. Young has been connected with Metal & Thermit's Chicago branch since its inception in 1912, being made District Sales Manager in 1926. He is an alumnus of the Armour Institute of Technology, a member of the AMERICAN WELDING SOCIETY and the American Society for Metals, and Vice-President of the Railway Appliances Association.

Merritt L. Smith, advertising manager of Metal & Thermit Corporation, has been appointed Assistant Sales Manager of the Corporation. Mr. Smith, whose headquarters are at 120 Broadway, New York, will continue to direct Metal & Thermit's advertising activities.

Mr. Smith, who has been with Metal and Thermit for ten years, was formerly a member of the staff of Rickard & Company, advertising agency. He is an alumnus of Dartmouth College and of Columbia University, from which he was graduated. He is a member of the AMERICAN WELDING SOCIETY and the National Industrial Advertisers Association.

ELEMENTARY METALLURGY

Elementary Metallurgy by W. T. Frier, Foundry Control Chemist, General Electric Company, Erie Works, Instructor in Metallurgy, General Electric Technical High School, Erie Works. This important new elementary text fills the need for a short course which will give students who have had no previous knowledge of the subject an opportunity to learn the characteristics of metals and the laws which govern them. The microstructure of metal is emphasized throughout the text with regard to the effect of rolling and forging, casting, heat treating, etc. All theories of hardening and of the control of hardness of all metals, ferrous and nonferrous, have been summarized under one head, i.e., strained, abnormal, atomic arrangement. Price $1.75. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y.

MEMBERS IN ARMED SERVICE

At the May 7th meeting of the Board of Directors and Executive Committee of the AMERICAN WELDING SOCIETY, the remittance of dues of members in the armed forces was considered and the following actions taken:

In the case of members who had joined or been inducted into the armed forces and who because of this are unable to meet dues payment, upon request to the SOCIETY, the name of such member shall be continued on an "inactive" membership list for the duration of the war.

In the case of members who have joined or been inducted into the armed forces and who because of this are unable to meet dues payment, upon application to the SOCIETY, such member can obtain THE WELDING JOURNAL during this period at a nominal annual fee of $2.00.

The first action is intended to permit a member to retain membership without interruption, but does not provide for furnishing him with THE WELDING JOURNAL or other publications of the SOCIETY during this period. The second action makes it possible for the member to continue to receive THE WELDING JOURNAL at nominal cost. These rulings do not apply to commissioned officers.

CORROSION RESISTANCE OF WELDED JOINTS

In THE WELDING JOURNAL, May 1942, pages 209-s to 237-s, there is given in two places on pages 212-s and 234-s, composition of Dowmetal M. This is slightly different than that shown and should be Mg + 1.5 Mn.

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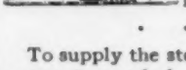

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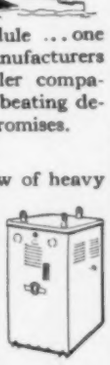

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(Continued from page 781)

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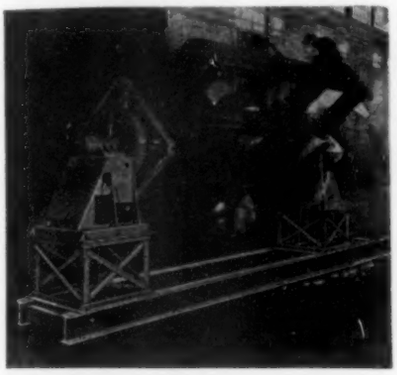
NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this Section

POSITION-WELDING HEAVY PIECES

A rotating welding fixture consisting of a Head-stock and Tail-stock combination for position-welding large cumbersome objects, such as that illustrated, has been developed and placed in service by the Industrial Division, Ransome Machinery Co., Dunellen, N. J.



The Head-stock table top is fixed in a vertical position with its spindle shaft turning in double Timken roller bearings. This unit is provided with power for rotating through a pinion in mesh with the table-top ring gear. The driving motor and self-locking gear reduction are completely enclosed within the main frame. The Tail-stock is essentially of the same design and construction as the Head-stock, but is not provided with power and functions as an outboard holding fixture. The distance between the Head-stock and Tail-stock is made variable to accommodate objects of different lengths, by mounting the Tail-stock on heavy I-beams and moving it to accommodate the object to be welded. Height adjustment is accomplished by providing simple subbases to suit the conditions of service. Both Head-stock and Tail-stock are of heavy all-welded construction and table tops are T-slotted to facilitate clamping.

Where a difference in elevation between the Head-stock and Tail-stock units is desired to provide additional downhand welding positions, the main base of the units is pivoted at one end and provided with a hydraulic jack at the other.

In some installations standard Ransome Welding Positioners have been used in combination with a Tail-stock unit so that the standard Positioner can be returned to its normal job after use as a Head-stock.

These tools are made in various standard sizes to handle objects weighing up to 16 tons.

NEW FUSION-WELDED JOINT

A new type of weld and welding procedure has been developed and is now in service permitting fusion butt-welded joints to be made which have complete penetration at the root of the weld. The method is applicable to both plate and tubular sections and results in the elimination of the backing rings or strips heretofore used in making welded pipe joints where welding can be done from one side only.

The new method is especially suitable in the welding of heavy wall pipe used under high pressure and high-temperature conditions. The absence of a backing ring and complete penetration to the root of the weld are of prime importance for this type of service.

In welding pipe for tubular sections, the method employs the following advantages:

- Provides greater flexibility in alignment of pipe, valves and fittings.
- Complete penetration to the root of the weld.
- No constriction in pipe area due to backing rings.
- No sacrifice in the strength of the pipe due to removal of wall for backing ring.
- Smooth pipe contour at the base of the weld with no "icicles" or protrusions.
- No gaps between rings and the inside of pipe wall caused by deformation of the rings during welding, allowing deposits to form within the pipe when in service.
- Full thickness of annealed metal, uniform in physical characteristics.
- Complies with recognized code requirements.

Further information can be obtained by writing to the W. K. Mitchell & Co., Inc., 2940 Ellsworth St., Philadelphia, Pa.

SILVER SOLDER FLUX

The latest development in silver solder flux is announced by the American Products Corp., 422 S. Dearborn St., Chicago, Illinois manufacturers of welding and brazing compounds.

One of the outstanding features of this new product is its low breaking point, becoming completely fluid at approximately 1065° F. Its composition is so balanced that it will not crystallize and when diluted with the proper amount of water it remains uniform. During brazing operations it throws off a soft green transparent flame, permitting full vision of the work.

It is especially adapted for use on stainless iron and stainless steel and also works perfectly on brass, copper, bronze, nickel alloys, Monel metal, etc. The product has been approved and is being used by the Navy.

ARC CONTROL STATIONS INCREASE PRODUCTION CAPACITY

Greater welding output per machine, better control by the operator and improved welds on thin gage metal. All of these are obtainable through the use of the Honey Bee Arc Control Station recently developed by Wilson Welder and Metals Co., New York, N. Y.

These arc control stations are made in capacities of 75 and 150 amp. They are an auxiliary electric device, connected in series with the welding circuit of any constant potential arc welding generator. Most conventional drooping voltage generators can be converted quickly and easily to constant potential. For this purpose, Wilson supplies a quick change switch mounted on the generator. A portable switch held in the operator's hand gives the operator remote control of the welding current within predetermined limits. This switch may be combined with the electrode holder, if desired.

When two or more Arc Control Stations are hooked up to a single generator, a like number of welding arcs can be operated simultaneously. Each operator can regulate his own current and weld as he sees fit without affecting the other in any way. One of the important features of this new arrangement is the remote control of the arc when the operator reaches the end of a bead, thereby enabling him to greatly improve the quality of the weld deposit at the crater. This is accomplished by gradually reducing the current which, in turn, reduces the heat and avoids porous, cracked craters and inclusions. Each operator has his choice of two methods of control:

1. He can set his Honey Bee to deliver a definite current at the arc and weld steadily at that setting.
2. He can use the hand switch to vary the current without breaking the arc. This enables him to start his arc on cold metal with a maximum current (hot arc) and to reduce the current as the work warms up.

ALUMINUM FLUX

An improved, free-flowing flux for the gas welding of aluminum and aluminum alloys is now being manufactured under the trade name of "Flo-Ez-Flux" by Park Stewart, 1061 Carbis St., Worthington, Pa. The manufacturer claims that as a result of improved methods of manufacture, Flo-Ez-Flux will positively not solidify or deteriorate.

Flo-Ez-Flux is being used to gas weld either wrought-, cast- or high-tensile aluminum or aluminum alloys, of any size or shape where welding is possible. It is being widely employed in the aviation industry.

Flo-Ez-Flux is packaged in a glass container, which prevents corrosion and protects the flux from moisture, and is available in a large number of sizes ranging from 1/4 lb. to 25 lb.

The manufacturer will furnish complete information on request.

"TEMP-A-TROL"

Revealed publicly by the Progressive Welder Co., Detroit, Mich., for the first time at the National Metals Exposition in Cleveland, October 12th to 16th, was a machine representing an entirely new approach to resistance welding.

The machine, the "Temp-A-Trol" forge welder, makes possible combined automatic spot welding and heat treating of alloy steels and heavy sections and permits the employment of relatively unskilled labor for spot-welding operations.

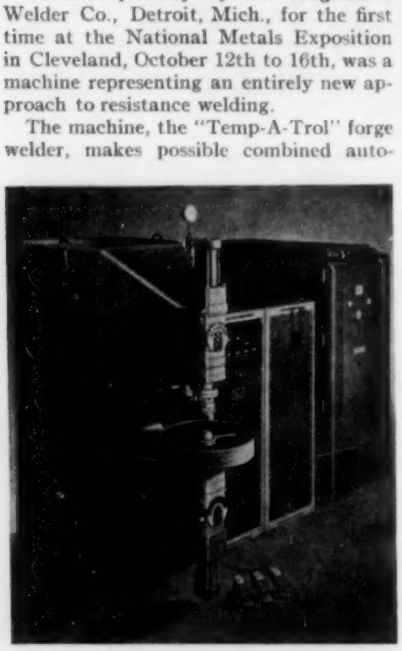


Fig. 1—A Complete "Temp-A-Trol" Welding Installation. Left to Right: the Welder, the Control Cabinet, Contactor Unit and "Frostrode" Refrigerator Cabinet

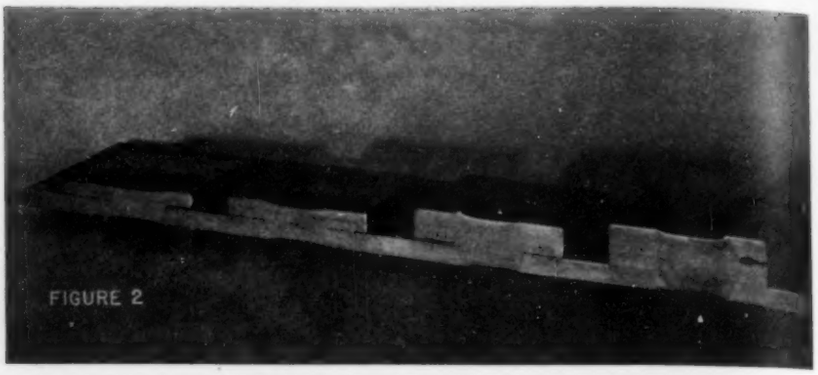


Fig. 2—All These Welds Were Performed Without Requiring Any Change in the Setting of the "Temp-A-Trol." The Bottom Plate Is 1/4 In. Thick

In general appearance, the "Temp-A-Trol" welder itself (see Fig. 1) does not differ radically from conventional spot-welding machines. In operation, however, it employs a completely new method of control, the weld itself automatically controlling the functioning of the machine.

The flexibility and simplicity in operation of the "Temp-A-Trol" welder in contrast are demonstrated by the fact that, without changing the machine controls, welds of exactly equal quality can be produced consecutively in 1/4 to 1/4 in., in 3/16 to 1/4 in., in 1/4 to 3/8 in. or in three sections of 1/4-in. material at the same time (see Fig. 2).

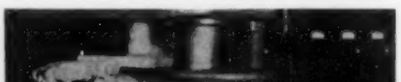


Fig. 3—Showing How Cold the "Frostrode" Unit Maintains Electrode Temperature, the Use of Cooling Jets of Water to Expedite Cooling, Etc.

In addition to this, the "Temp-A-Trol" welder can be used to automatically heat treat the weld in the same operation. This postheat refines the grain size of the weld, increasing its ductility, gives the proper grain structure and "tempers" the weld nugget and adjacent area to any desire amount consistent with the characteristics of individual alloys. It eliminates the accepted "necessary evil" of coarse and brittle grain structures when welding alloy steels and heavy sections.

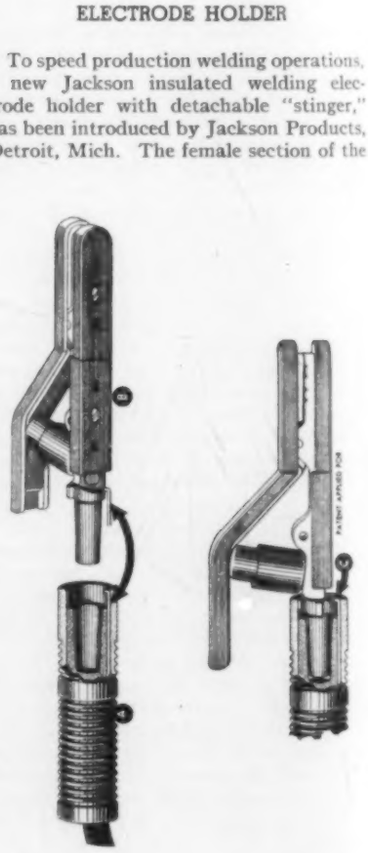
To set the controls of the "Temp-A-Trol" welder it is necessary only to determine the temperatures which will produce the best weld and heat-treat characteristics in any given material. This is a relatively simple matter.

The controls of the machine are then set to values corresponding to these temperatures. After the controls are once set, the machine will automatically compensate itself and reproduce identical quality welds under wide ranges of variation as to metal thickness, cleanliness of metal and other welding conditions.

The basic element of the control which makes this possible is the incorporation in one of the welding electrodes of a highly sensitive thermocouple. This thermocouple automatically shuts off the current when the correct temperature is reached, turns it on again when the weld has been cooled to the proper degree, turns it off when the correct heat-treat temperature has been reached, etc.

ELECTRODE HOLDER

To speed production welding operations, a new Jackson insulated welding electrode holder with detachable "stinger," has been introduced by Jackson Products, Detroit, Mich. The female section of the



cable connector is permanently soldered to the cable lead and remains in the insulated handle, *A*. The detachable jaw section—the "stinger," *B*—is snapped into the female section by a quick twist of the operator's wrist and is ready for business. The actuating cam mechanism that locks male and female sections together is shown at C. The lock is said to be positive and may be quickly disengaged.

This new holder, called the Jackson "Quik Trik," is made in three models, *all* insulated—Model TA-1, 300 amp. with stationary jaws; Model TA-2, 300 amp. with replaceable jaws of Mallory 3 Metal; and Model TA-3, 500 amp. also with replaceable jaws of Mallory 3 Metal.

Employment Service Bulletin

SERVICES AVAILABLE

A-444. Inspector, Supervisor and Instructor of Welding. 20 years' welding experience—oxyacetylene and arc—practical welder. Knowledge of metallography, heat treating and physical metallurgy. Capable of performing all tests and investigations of weld metal. Sales experience. Consider position outside U. S. A. Draft classification 3B.

POSITION VACANT

A-120. Wanted Welding Engineer for field service and laboratory development work on coated copper alloy electrodes. Prefer man with metallurgical background and actual welding experience. All war work now with good future. Location in Midwest. Advise draft status in your reply.

SECTION ACTIVITIES

CLEVELAND

The feature of the regular meeting of the Cleveland Section on Wednesday evening, October 7th, at the Cleveland Engineering Society Building, was the showing of the new training films, "The Inside of Arc Welding."

These films were produced by the Raphael G. Wolff Studios of Hollywood, working under the technical supervision of the General Electric Welding Laboratories and with the cooperation of Government and industry representatives. It has been estimated that the time to train a welding operator can be reduced by at least 20% through the use of these films.

The "coffee talk" following the dinner was by Mr. James F. Lincoln, President of the Cleveland Chamber of Commerce and President of The Lincoln Electric Co. on "The Future of the War." Mr. Lincoln gave his view of the progress and conduct of the war from an industrial standpoint.

The Cleveland Section has scheduled the following list of topics to be discussed during the coming season:

Nov. 11, 1942—"Outline of Electric Welding and Equipment," by K. L. Hansen, Consulting Engineer, Harnischfeger Corp.

"Electrodes and Their Proper Use," by H. O. Westendarp, Jr., General Electric Co.

December—"Liberty Ships."

January 1943—"Fundamentals of Oxyacetylene Welding;" "Oxyacetylene Equipment."

February 1943—"Stainless Steel."

March 1943—"Resistance Welding."

April 1943—"Welding in Aircraft."

May 1943—"Annual Welding Symposium."

The Engineering Defense Training Program has offered the Cleveland Section two courses in Welding. These courses started the week of September 13th at Case School of Applied Science and continue one night per week for fifteen weeks.

Welding Laboratory—Course ME 5.1—Monday or Wednesday evenings, 6:30 P.M.

Subject	Lecture Hours	Laboratory Hours
Oxyacetylene Welding Equipment and Its Uses	2	13
Fundamentals of Arc Welding	2	8
Types of Welds and Joints	1	6
Warpage or Distortion Control	1	..
Welding Symbols	1	..
Controlled Atmosphere Brazing	1	..
Metallurgy of Welds	1	..
Non - destructive Testing	1	3
Welded Machinery	1	..
Oxyacetylene Cutting and Equipment	1	6
Non-ferrous Welding	1	6
Resistance Welding	1	3
Atomic Hydrogen and Thermit Weld	1	..

Resistance Welding Course ME 17.1—Monday evenings, 6:30 P.M.

This is a complete resistance welding course covering all types and phases of resistance welding and we recommend this as an advanced course for welding engineers.

Only a Limited Number Will Be Enrolled in Each Course!

Applications for enrolment may be obtained from Robert J. Kriz at 1360 W. 3rd St., Cleveland, Ohio (The James H. Herron Company). Telephone MAin 5443.

The cost of enrolment is only $1.00 to defray expenses of the Cleveland Section, A.W.S.

VERY IMPORTANT!!! Enroll at the very earliest moment to be assured of receiving the benefits of attending class.

All classes will be held at Bingham Hall, Case School of Applied Science.

COLUMBUS

The October meeting of the Columbus Section was held on the 9th at the Fort Hayes Hotel. "The Inside of Welding," a sound moving picture, was shown through the courtesy of the General Electric Company.

On October 22nd, Professor Clyde T. Morris, Chairman of the Civil Engineering Department of The Ohio State University, addressed the Student Branch of the Section. The speaker at the November meeting will be Mr. Robert D. Williams of Battelle Memorial Institute.

The following is the program of meetings of the Columbus Section for the season:

November 13, 1942—Dinner Meeting, Hotel Fort Hayes. "Mechanical Properties of Weld Metal," by Orville T. Barnett, Metal and Thermit Corp.

December 11, 1942—Dinner Meeting, Hotel Fort Hayes. "Utility Characteristics of Aircraft Electrodes," by R. D. Williams, Battelle Memorial Institute.

January 8, 1943—Meeting, Battelle Memorial Institute. "Unfinished Rainbows" (Color Movie) and "How to Weld Aluminum" (Movie), Aluminum Company of America.

February 13—Dinner Meeting, Hotel Fort Hayes.

March 12—Dinner Meeting, Hotel Fort Hayes. "Arc Welding Road Equipment," by Elmer Isgren, R. G. LeTourneau, Inc.

April 9—Dinner Meeting, Hotel Fort Hayes.

May 14—Meeting, Battelle Memorial Institute. "Resistance Welding in War Effort," by B. L. Wise, Federal Welder & Machine Co.

Dinner at 6:30 P.M.; technical sessions start promptly at 8:00 P.M.

DETROIT

The regular monthly meeting of the Detroit Section was held on October 2nd at Rackham Educational Memorial Building. Mr. Leon C. Bibber, Carnegie-Illinois

Company, spoke on "Plate Preparation for Arc Welding;" Mr. J. H. Cooper, Taylor-Winfield Corporation, spoke on "Sheet Metal Surface Preparation for Resistance Welding, Aluminum More Especially." These presentations were followed by a question box period—Technical Discussion, with Mr. Earl H. Foss, Murray Body Corporation acting as Technical Chairman.

KANSAS CITY

The Kansas City Section got off to a good start on October 6th, with an attendance at dinner with Mr. Jas. F. Lincoln, The Lincoln Electric Company as the speaker. The subject was "Welding Inhibitions" and it became evident that the pampered sons of the pioneers are losing their traditional originality and ingenuity. They seem unwilling in military and manufacturing circles to do anything unless it has been done before that way. It was a thought-provoking address, and many plants in Kansas City will undoubtedly be doing things with methods not found "in the books."

Five new members added zest to the first meeting, showing the good work of the New Membership Chairman, Mr. Ed. Cellwork. In spite of the war, it looks as if the Kansas City section this year, will conduct a monthly series of very interesting meetings. Under the able leadership of our new *Chairman*, Mr. Wm. S. Farr, the future of the "Heart of America" group looks bright.

MARYLAND

Mr. B. J. Brugge, Welding Engineer of The Lincoln Electric Company, addressed the October 16th meeting on "Designing for Welded Joints." At the meeting Past-Chairman pins were presented to H. N. Boetcher, Bela Ronay, John W. Miller, R. A. Mansfield and C. N. Hilbinger.

MILWAUKEE

A welding address on "Welding of Air Hardenable Steels" was given by Mr. Harold N. Ewertz of Arcos Corporation at the September 25th meeting of the Milwaukee Section. Mr. Ewertz' talk covered some of the fundamentals to be considered in the welding of air hardening steels. An after dinner talk on "Unprotected Milwaukee" was made by Professor O'Neill Olson of Marquette University.

NEW YORK

The New York Section of the AMERICAN WELDING SOCIETY held its regular monthly technical meeting on October 6, 1942, at the Engineering Societies Building. Technical chairman for the evening was A. B. Kinzel, Chief Metallurgist, Union Carbide and Carbon Research Laboratories, Inc., New York.

The speaker for the evening was Charles M. Parker, Secretary, General Technical Committee, American Iron and Steel Institute, New York, who spoke on the subject, "The Conservation of Steel-Making Raw Materials." Mr. Parker began by emphasizing the scarcity of many of the critical alloying materials used in the production of alloy steels. Following this, Mr. Parker discussed in detail the recently introduced National Emergency steels. He pointed out that in spite of the fact that these steels use less percentages of alloying metals, their physical properties were comparable to the higher alloy steels which they replace. Mr. Parker accompanied his interesting talk with numerous lantern slides. During the discussion which followed, Dr. Kinzel described the weldability of these new steels.

Following Mr. Parker's talk, the first three reels of the all-color, sound motion picture, "Fundamentals of Arc Welding," were presented through the courtesy of the General Electric Company. These films illustrated what actually goes on inside the arc with details of arc and crater clearly revealed.

The evening opened with a half-hour question and answer period conducted by H. R. Morrison, The Linde Air Products Company, New York.

NORTHERN NEW JERSEY

The regular monthly meeting of this Section was held on October 20th at Essex House, Newark. Mr. C. H. Jennings of the Westinghouse Electric & Mfg. Co. spoke on the subject "Usual Distortion Problems Encountered in Welding and How to Meet Them." An educational film was shown through the courtesy of the Standard Oil Co. of N. J.

NORTHWEST

The first meeting of the current season was held on September 17th at the St. Anthony Commercial Club, Minneapolis. Dinner preceded the meeting. The General Electric Company film "The Inside of Arc Welding" was shown in its entirety.

Mr. H. C. Boardman, Research Engineer, Chicago Bridge & Iron Company, spoke on "Locked-Up Stresses in Steel Structures," at the October 19th meeting.

Programs for coming meetings of the Section are as follows:

Nov. 16, 1942—"Oxy-Acetylene Processes That Eliminate Bottlenecks," W. B. Browning, The Linde Air Products Co.

Dec. 15, 1942—"The Principles of Magnaflux Inspection," George L. C. Dehn, Magnaflux Corporation.

Jan. 18, 1943—"Welding of Copper Alloys," C. E. Swift, Ampco Metal, Inc.

Feb. 15, 1943—"Cost of Welding," J. M. Jardine, Western Welding & Boiler Repair Co.

Mar. 15, 1943—"Stainless Welding," Harold N. Ewertz, Arcos Corporation.

Apr. 14, 1943—"Spot and Resistance Welding," R. E. McFarland, Western Electric Company.

May 18, 1943—Annual Meeting.

PHILADELPHIA

A "Welding Round Table" was the theme of the September 21st meeting, which was preceded by the showing of Reels 1 and 2 of the General Electric's film "Inside of Arc Welding," and extremely interesting discussion developed along a number of lines. Methods of overcoming "Arc Blow" were discussed and suggestions offered on the conservation of electrodes, welding equipment, gases and cylinders.

"Cutting and Welding on Liberty Ships" was the interesting and timely subject by Mr. J. G. Magrath of Air Reduction Sales Company, at the October 19th meeting. The Marine Commission approved the reading of the paper and the showing of the slides.

ROCHESTER

The October meeting of the Rochester Section of the AMERICAN WELDING SOCIETY was held October 1, 1942, at Todd Union, University of Rochester. The meeting opened with a dinner, after which, the members adjourned to Lower Strong Auditorium where the Past-Chairman's pin was presented to Professor W. J. Conley of the University of Rochester. The General Electric Kodachrome movie, "The Inside of Arc Welding" was shown. An unusually large attendance at this first meeting promises a successful season for the Rochester Section.

SAN FRANCISCO

The September meeting of the AMERICAN WELDING SOCIETY, San Francisco Section, was held at the Athens Club, Oakland, Calif., on Friday, September 25, 1942.

There were approximately 80 members and guests in attendance.

The first portion of the meeting was conducted by Mr. O. Ovregaard, Assistant Naval Architect, Moore Dry Dock Navy Yard, Oakland. Mr. Ovregaard's talk on "Welded Ship Construction in the United States and Europe" was exceptionally interesting and enlightening.

The last portion of the meeting was conducted by Mr. Charles E. Smith of The Linde Air Products Company and the moving pictures, "Automatic Machine Cutting" and "Shaping Steel" gave many of us a new slant on how production is increased through the use of automatic machine cutting.

SOUTH TEXAS

The South Texas Section resumed activities on September 25th with a meeting at the Houston Engineers' Club, Houston, Texas. Some sixty members were present to see a complete showing of the full color movies made by the General Electric Company titled "Inside of Welding."

Mr. George Steffan of the Wessendorff-Nelms Company discussed recent developments in the manufacture of electrodes for use with alternating current, and cited the limitations that this method of welding has suffered up to the present time. Mr. Steffan indicated that latest improvements in the manufacture of these electrodes make them suitable for welding in all positions, and a motion picture demonstration of proper welding procedure was given.

WASHINGTON, D. C.

At the opening meeting on October 2, 1942, the Section was privileged to have as

its guest speaker, Mr. W. K. Ostrom of the welding branch of the War Production Board, who gave a brief outline on the way they handle the many problems on apparatus and supplies for the industry. This talk was most enlightening. The speaker of the evening was Prof. T. McLean Jasper of the A. O. Smith Corp., who addressed the local chapter on the subject of "Layer Pressure Vessels and Allied Welding Problems." This talk was of considerable interest to all present and was expressed by the great many questions that followed the lecture.

The Washington Section held its annual opening dinner preceding the general meeting.

YORK-CENTRAL PA.

"A.C.-D.C. Welding" was the subject of Mr. Charles H. Jennings of the Research Laboratory, Westinghouse Elec. & Mfg. Co., at the September 16th meeting.

"Modern Welding Procedures" was the subject in two parts as presented by Messrs. Eli Anderson and Richard Lee at the October 7th meeting. Mr. Anderson of York Ice Machinery Co. gave a résumé of various types of modern welding procedures. Mr. Lee, Metallurgist of The McKay Co. discussed characteristics and functions of welding rod coatings.

List of New Members

September 1 to September 30, 1942

BIRMINGHAM

Deas, R. R. (C), American Cast Iron Pipe Co., Birmingham, Ala.

BOSTON

Johnson, Clifford H. (D), 30 Whitney Rd., Quincy, Mass.
Lamontagne, Joseph A. (D), 13 Champlain Ave., Lawrence, Mass.
Zwicker, Earle F. (D), 126 Grand View Ave., Wollaston, Mass.

CANADA

Freeman, F. E. (C), Sheldon's Ltd., Grand Ave., Galt, Ont., Canada.
Haneharek, Nick (D), 518 Wellington, W., Toronto, Ont., Canada.
Nixon, George M. (F), Canadian Allis-Chalmers Co., Shipshaw, Que., Canada.
Take, Percival H. (B), 151 St. Germain Ave., Toronto, 12, Canada.

CANTON

Englehart, John D. (D), 2248 Mahoning Rd., N. E., Canton, Ohio.

CHICAGO

Andrews, Reginald A. (B), 427 W. Erie St., Chicago, Ill.
Bilek, Frank J. (C), The Globe Co., 4000 S. Princeton Ave., Chicago, Ill.
Brock, Nick (D), 5543 S. Neenah Ave., Chicago, Ill.
Comar, Jerome M. (C), Maremont Automotive Prod., Inc., 1625 S. Ashland Ave., Chicago, Ill.
Dinse, Walter (C), Clearing Mach. Corp., 6499 W. 65th St., Chicago, Ill.
Miller, Jack J. (D), 2639 W. Rice St., Chicago, Ill.
Pomperger, Frank A. (D), 4918 Todd Ave., E. Chicago, Ind.
Smith, Lloyd M. (C), Utilities Engrg. Inst. 1314 Belden Ave., Chicago, Ill.
Stewart, Roy L. (D), 3403 W. Jackson Blvd., Chicago, Ill.

CINCINNATI

Polacheck, A. G. (C), 7 S. Wilkinson, Dayton, Ohio.

CLEVELAND

Berlin, Jack J. (C), The American Shipbldg. Co., Ft. of 54th St., Cleveland, Ohio.
Bumblis, Wm. (B), 4096 Rocky River Dr., Cleveland, Ohio.
Gall, Frank M. (C), 2923 E. 118th St., Cleveland, Ohio.
Jarms, J. J. (D), 2203 Walnut Blvd., Ashtabula, Ohio.
McCashen, Rolla (B), 10518 Parkhurst Dr., Cleveland, Ohio.
Myers, William M. (C), 4062 W. 140th St., Cleveland, Ohio.
Pfabe, Leonard C. (D), P. O. Box 318, Fairview Ave., Atwater, Ohio.
Priesand, I. T. (B), American Shipbldg. Co., 1410 Terminal Tower, Cleveland, Ohio.
Sessions, Robert C. (B), Brown Fintube Co., Filbert St., Elyria, Ohio.
Swanson, Oscar S. (B), 19631 S. Sagamor Rd., Rocky River, Ohio.

CONNECTICUT

Mehl, Eugene L. (D), 168 Mansfield St., New Haven, Conn.
Peltier, Eugene J. (D), 79 Cherrelyn St., Springfield, Mass.

DETROIT

Bellfi, Omer H. (C), 144 E. Henry St., River Rouge, Mich.
Brams, Stanley H. (C), 7310 Woodward Ave., Detroit, Mich.
Chisholm, V. H. (B), Hudson Motor Car Co., Body Plant, Detroit, Mich.
Corp, Paul M. (C), 2285 Glynn Court, Detroit, Mich.
Crigger, Harry (B), Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich.
Davey, Geo. T. (B), 314 Manistique, Detroit, Mich.
Femminineo, T. (B), Hudson Motor Car Co., Gratiot Plant, Detroit, Mich.
Ferris, Russell (C), 1055 E. Bristol Rd., Flint, Mich.
Kessler, Frank E. (B) G-2188 Red Arrow Rd., Flint, Mich.
Koulouras, George K. (B), Hudson Motor Car Co., Detroit, Mich.
Massey, W. E. (B), Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich.
Ringer, Luther C. (C), 1410 Lippincott Blvd., Flint, Mich.
Smith, Joseph C. (B), Weldit Acetylene Co., 638 Bagley Ave., Detroit, Mich.
Spurling, William P. (C), 3910 Mannhall St., Flint, Mich.
Station, James E. (D), 6339 Yinger, Dearborn, Mich.
Timmons, George A. (B), Climax Molybdenum Co. of Mich., 14410 Woodrow Wilson, Detroit, Mich.
West, C. L. (B), Hudson Motor Car Co., Detroit, Mich.
Withers, Frank J. (C), 14189 Seymour Ave., Detroit, Mich.

GEORGIA

Dukes, Thomas B. (C), R.F.D. 1, Box 246A, Savannah, Ga.

INDIANA

Brattain, Raymond F. (D), 223 Ringwood Way, Anderson, Ind.
Lenz, John J. (D), R.F.D. 5, Elwood, Ind.

KANSAS CITY

Merrick, Robert L. (C), The Fluor Corp., Ltd., 714 Fairfax Bldg., Kansas City, Mo.

LOS ANGELES

Aufmann, Joseph (C), 1505 S. Adams St., Glendale, Calif.
Bancroft, M. (D), 4568 Verdemour Ave., Los Angeles, Calif.
Burke, Edmund M. (D), 2742 Illinois Ave., Southgate, Calif.
Burstein, M. (D), 930 Court St., Los Angeles, Calif.
Clayton, Lewis R. (C), 2306 S. 73rd St., Los Angeles, Calif.
Coulter, N. H. (C), 2649 Jackson St., Long Beach, Calif.
Dorsett, Blaire (C), Vega Airplane Co., Plant 2, Burbank, Calif.
Eckles, Paul N. (C), 526 High St., Whittier, Calif.
Edwards, Harry E. (C), 1030 Walnut Ave., Long Beach, Calif.
Ferguson, Nathan S. (C), 1065 E. Ocean Ave., Long Beach, Calif.
Forman, Milton (C), 2619 Virginia Rd., Los Angeles, Calif.

Gibbons, Chas. B. (D), 3036 Grand Ave., Huntington Park, Calif.
Gordillo, Marquez F. (D), 314 Bayview, Wilmington, Calif.
Hays, Manford M. (C), 214 Amar St., San Pedro, Calif.
Hirsch, Walter F. (B), 7108 Arbutus Ave., Huntington Park, Calif.
Horn, Henry, (C), 10013 Otis St., Southgate, Calif.
Hurt, Samuel C. (C), 2113 Rockhold Ave., Rosemead, Calif.
McMullen, Jack (C), 400 N. Culver, Compton, Calif.
Mitchell, William B. (C), U. S. Navy, Supervisor of Shipbldg., San Pedro, Calif.
Morrison, Orville K. (D), 111 E. 106th St., Los Angeles, Calif.
Nissen, Paul (C), 237 Corona Ave., Long Beach, Calif.
Polf, Eddie C. (C), 1163½ E. 77th Place, Los Angeles, Calif.
Rhoad, Julius (C), 1610 E. Ocean, Apt. 2, Long Beach, Calif.
Schmitz, John W. (D), 315 W. 20th St., Long Beach, Calif.
Slater, Evertt (C), Vega Aircraft Co., Plant 2, Burbank, Calif.
Smith, Andrew M. (C), 903 Lakme Ave., Wilmington, Calif.
Stephenson, Ferrald D. (C), 1308 E. 152nd St., Compton, Calif.
Talkington, Glenn E. (D), 211 S. 5th St., Oxnard, Calif.
Wade, John D. (C), 2238 Alma, San Pedro, Calif.
Walker, S. F. (C), 3450 Gaviota, Long Beach, Calif.

LOUISIANA

Marusic, Staff Sgt. Frank R. (D), Co. 15, 1st Prov. Bn, Pakenham Sta., New Orleans, La.

MILWAUKEE

Lynch, David F. (C), 8101 S. Oklahoma Ave., Milwaukee, Wisc.
McClay, Ernie (D), 1114—16th Ave., S. Milwaukee, Wisc.
Ramsey, James W. (C), % South Milwaukee School of Voc., Memorial Sq. at Pine St., S. Milwaukee, Wisc.

NEW YORK

Clements, Macmillan (B), United States Plywood Corp., 616 W. 46th St., New York, N. Y.
Ferguson, Frank A. (D), 644 E. 49th St., Brooklyn, N. Y.
Goldsmith, Bernard (D), 34–12—34th St., Astoria, L. I., N. Y.
Grasier, Leonard L. (D), 738 Requa St., Peekskill, N. Y.
Loeb, Carl M. Jr. (B), Climax Molybdenum Co., 500—5th Ave., New York, N. Y.
Randall, David (C), Randall Welding Wks., 35 Crosby St., New York, N. Y.
Randall, Max (F), Randall Welding Wks., 35 Crosby St., New York, N. Y.
Shamis, J. T. (B), American Chemical & Flux Co., 520 W. 48th St., New York, N. Y.

NORTHERN NEW JERSEY

Black, Owen H. (D), 28–30 Sherman Pl., Jersey City, N. J.
Grebas, George C. Jr. (C), 435—3rd Ave., Elizabeth, N. J.
Jorgensen, Thomas (C), Anderson's Mach. Shop, 401 N. Rio Grande Ave., Wildwood, N. J.
Krasnovsky, Andrew (D), 1086 Alina St., Elizabeth, N. J.
Shaffer, Basil K. (D), 189 Hunterdon St., Newark, N. J.

NORTHERN NEW YORK

Fatato, Lawrence A. (D), 1629 Van Vranken Ave., Schenectady, N. Y.
Quick, Roy B. (C), R. D. 7, Schenectady, N. Y.
Rood, Robert M. (D), General Elec. Co., Welding Dept., Wks. Lab., Schenectady, N. Y.
Woodruff, Charles F. (C), 407 Victory Ave., Schenectady, N. Y.

NORTHWEST

Blank, Maynard J. (C), 4700 Columbus Ave., Minneapolis, Minn.
Born, Arthur C. (C), 5229—36th Ave., S., Minneapolis, Minn.
Hoppenstedt, V. J. (C), 2720—15th Ave., S., Minneapolis, Minn.
Jansen, Walter R. (C), Rt. 5, Como Sta., St. Paul, Minn.
Johnson David (C), 3913—25th Ave., S., Minneapolis, Minn.
Olson, Albert C. (B), 4154 Reservoir Blvd., Columbia Hgts., Minn.
Palmer, H. C. (A), St. Paul Structural Steel Co., St. Paul, Minn.
Peterson, Harry (D), 3528—36th Ave., S., Minneapolis, Minn.
Smith, H. W. (C), 2807 Lyndale, N., Minneapolis, Minn.
Swanson, Rolf G. (C), 2880 James Ave., S., Minneapolis, Minn.

PEORIA

Hogan, Leroy J. (B), Chicago Bridge & Iron Co., Asst. Supervisor of Shipbldg., Seneca, Ill.
Jackson, K. H. (B), 307 Jefferson St., Washington, Ill.
Talkington, Earl (B), 120 Linden Lane, E. Peoria, Ill.

PHILADELPHIA

Brumbley, Joseph M. (C), R.D. 2, Faulk Rd., Wilmington, Del.
Carney, J. E. (C), Sun Oil Co., P.O. Box 426, Marcus Hook, Pa.
Lightbody, Albert (B), E. I. Du Pont de Nemours & Co., Newport, Del.
Marcelo, Arthur P. (C), 3341 Brandywine Sts., Philadelphia, Pa.
Maxwell, J. Rogers (C), 310 S. 10th St., Philadelphia, Pa.
Noble, Charles R. (C), 2210 Jessup St., Wilmington, Del.
Pajewowski, Theodore E. (C), 224 Stroud St., Wilmington, Del.
Parsons, William R. (C), Box 64, Holly Oak, Del.
Preston, Richard H., Sr. (D), 249 Woodlawn Terrace, Collingswood, N. J.
Sargent, Walter H. (C), 401 S. 14th St., Wilmington, Del.
Schmidt, F. A. (B), Sun Oil Co., Marcus Hook, Pa.
Simpkins, Andrew (C), 136 Monroe Ave., Magnolia, N. J.
Smith, Kermit J. (C), 5 Naylor Ave., Penns Grove, N. J.
Zimmy, Charles J. (C), 929 Chestnut St., Wilmington, Del.

PITTSBURGH

Liedholm, C. A. (B), 918—7th St., Beaver, Pa.
Wake, Bert T. (C), 718 Washington St., Sewickley, Pa.

PUGET SOUND

Ball, George H. (B), Box 221, Mercer Island, Wash.

ROCHESTER

Parker, Jack (D), 558 Flint St., Rochester, N. Y.

ST. LOUIS

De Leal, R. (C), 1905 Kienlen St., St. Louis, Mo.
Harris, A. W. (B), Western Cartridge Co., E. Alton, Ill.
Lawrence, Elmer J. (C), 7043 Tulane Ave., University City, Mo.
Orr, John O. (C), 2118 Edmund St., Pine Lawn, Mo.

SAN FRANCISCO

Bamberger, Sidney F. (C), Pollock-Stockton Shipbldg. Co., P.O. Box 1848, Stockton, Calif.
Drachenfels, Alec (D), 2278 Grove St., San Francisco, Calif.
Hines, Wilson S. (C), Pollock-Stockton Shipbldg. Co., Box 1848, Stockton, Calif.
Jessee, Arthur E. (C), Tide Water Associated Oil Co., Associated, Calif.
Lowry, Gordon (D), Foundry, U.S.S. Tennessee, San Francisco, Calif.

SOUTH TEXAS

Carpe, Stanley A. (C), A. O. Smith Co., 817 Niels Esperson Bldg., Houston, Tex.
Curtin, G. Rex (D), 118½ Ohio, Baytown, Tex.
Fosson, F. P. (D), 2716 Truxillo Ave. Houston, Tex.

TULSA

Swan, Felix D. (D), 1162 Walnut St., Muskogee, Okla.
Sweigart, William C. (D), 26 N. Nogler Ave., Tulsa, Okla.

WASHINGTON, D. C

Darby, James L. (D), Naval Research Lab., Washington, D. C.
Darcey, James F. (C.), 4412 Warren St., N.W., Washington, D. C.
De Shazer, Grant A. (C), 6209 Vorlich Lane, Fairway Hills, Washington, D. C.
Handova, Charles W. (C), 2C530 Pentagon Bldg., Washington, D. C.
Vosburgh, J. C. (C), Chicago Bridge & Iron Co., 632 Washington Bldg., Washington, D. C.

WESTERN NEW YORK

Knight, Ira (D), 37 E. Main St., Gowanda, N. Y.

NOT IN SECTIONS

Arthur, R. V. (D), 102 N. 5th St., Monroe La.
Bates, Malcolm H. (D), Hq. Co. 106th Q. M., BN, 31 Inf. Div., % Postmaster, Leesville, La.
Begor, William E. (B), North Carolina Shipbldg. Co., Wilmington, N. C.
Bledsoe, L. F., Jr. (B), Newport News Shipbldg. & D.D. Co., Welding Engr's. Office, Newport News, Va.
Broughton, Wm. H. (D), 325—9th St., Ashland, Ky.

Browning, Dean E. (D), 421 E. 5th St., Hope, Ark.
Cartmell, H. W. (D), 725 Bellefonte Rd., Ashland, Ky.
Comstock, Clyde C. (C), R.R. 1, Cor. Holt and Mitchaw Rds., Sylvania, Ohio.
Crace, Gus (D), 2501 Beech St., Ashland, Ky.
Evans, J. O. (C), 3913 Elkins Ave., Nashville, Tenn.
Frazier, E. W. (B), Tuskegee Inst., P.O. Box 473, Tuskegee, Ala.
Henry, Dallas T. (D), 920 Montgomery Ave., Ashland, Ky.
Herrmann, L. T. (B), P.O. Box 1155, Chickasaw, Ala.
Hughes, John K. (D), 301 Penn Ave., Martinsburg, W. Va.
Kreiser, G. F. (D), 1720 Willard Ave., S.E., Grand Rapids, Mich.
Laudig, J. J. (B), Delaware, Lacka. & Western R. R. Laboratory, Scranton, Pa.
Pynn, J. G. (C), Wampsville, N. Y.
Radke, Frank (D), Riceville, Iowa.
Rolfe, S. E. (D), 2315 Montgmeory Ave., Ashland, Ky.
Ross, Garrett R. (D), 2420 Roosevelt Ave., Ashland, Ky.
Stephens, C. C. (B), P. O. Box 298, Fernandina, Fla.
Stucky, Marion W. (C), R. R. 1, New Albany, Ind.
Thompson, J. H. N., J. H. N. Thompson, Olverhampton Lt., Wolverhampton, England.
Torgler, E. R. (B), Dresser Mfg. Co., Bradford, Pa.

PRESIDENT'S REPORT TO THE MEMBERS OF THE AMERICAN WELDING SOCIETY

For the Administrative Year Ended September 30, 1942

By G. F. Jenks

The report of activities of the Society are given in the reports of the Secretary and of the Chairman, Outline of Work Committee.

For the first time in its history, the Society has entered a period of war. It is conscious of its duty to serve and of its ability to render service and is conducting its affairs and programs to accomplish the maximum in the conduct of the war.

Organized primarily to assist its members professionally, a technical society incurs a public duty because of its ability to render service. Our Society is the only organization in this country in the field of welding and includes in its membership the leading welding engineers of the country and others associated with the industry. Because of these facts, it is in a position to serve each community in which its Sections exist and the nation as a whole. It has attempted to fulfill these obligations during the past year and will continue to carry out a policy of public service.

Contacts have been established with national agencies, such as the War Production Board and various Bureaus of the War and Navy Departments. Some of these contacts have been highly productive and have resulted in the preparation and adoption of standards which were accepted by industry and government agencies. But full use of the Society is not being made by government bureaus in the preparation of standards that might be of great value in developing acceptable production practices.

There are many reasons why the Society's organization has not been fully utilized by the government. One principal reason has been the philosophy of government specifications that the end product should be specified and that the fabricator should be given freedom in the selection of processing methods. In the newly developed war products industries, fabricators have looked to government agencies to specify standards and to maintain standardization of products. Except in isolated cases, fabricators have not recognized the advantages of taking the initiative in the preparation of standards and recommended practices. In failing to inaugurate standardization work, industry is neglecting an opportunity of service to the nation by helping technically weaker production units, thus speeding up production, and to decrease the cost of production. Many of the unduly severe restrictions of government specifications and the interpretation of them would disappear if there were available standards and recommended practices representative of good welding procedure.

The Society can further assist the War Program by studying the needs of war fabricators and taking the initiative in organizing standardization activities. Steps have been taken to secure the cooperation of government bureaus in such a program.

The Society is in an excellent position for a more intensive standards program. Our technical committee procedure has been reorganized placing greater authority and responsibility upon the committee. The Outline of Work Committee, with relief from details, is given a better opportunity to study policies and the general needs of industry. There is still a need of studying the technical organization of the Society to simplify it. There are too many technical committees. Some of them should be combined as subcommittees into a single committee of broader scope and greater authority.

At present the responsibility for organization of technical activities rests with the Committee on Outline of Work. The problem of simplification and improvement of our technical activities has been presented to it and it is hoped that experience under the revised rules has now been sufficient for that committee to make recommendations to the Board.

The shortened procedure for the preparation of War Standards has operated to reduce appreciably the time required to promulgate standards.

The preparation of standards of war application is the primary present obligation of the Society. The application of the term "war application" must not be too narrowly interpreted. It is doubted that there is any standard of the Society which is not applicable to the War Production Program. Some may be of indirect application. The Welding Industry cannot afford to neglect this work except for a war of short duration. It is safe only to prepare for a war of long duration and it is hoped that our technical committees will organize their work on such a basis.

It has been the policy of the Society to cooperate fully with other technical organizations in its standards work. The time has now arrived for a more complete utilization of the American Standards Association in the promulgation of welding standards.

Our technical committees are to be commended upon the work accomplished during the past year. There remains a large amount of work to be taken up which will place a greater burden upon these committees. Their services are needed for increasing the efficiency of the War Program.

Our Educational Committee has accomplished some constructive work in formulating an industrial definition of the term "welding engineer." Will our educational institutions provide the training required to meet industry's specification? Only one university meets these requirements at present. Certainly there is a demand for welding engineers and a woefully inadequate supply.

Many of the Society's Sections are to be commended for local activities to assist war production activities. These activities have included lecture courses, assistance to local engineering schools in the organization of National Defense Engineering Training courses, local conferences and special consulting service to war fabricators. Activities of these types are needed especially in these days of great demand for welding engineers and a large turnover in employment.

The building up of large industries employing welding in regions remote from sections now existing makes it more difficult for the Society to discharge its obligations, and for welding engineers to take advantage of the Society to perform needed community service. This is one of the unsolved problems.

There is a tendency for the war censorship to prohibit the free publication of technical information, especially the results of research and development. Of course information concerning war products is a matter for censorship. Welding, however, is a process, not a product. There is a great need for more information as to the fundamentals and applications of the process. Latest developments have not been applied in some plants because of lack of information of what has been accomplished elsewhere. Production has been slowed down and quality of product has been needlessly inferior, because needed technical information was not available to the operating engineer.

Limited circulation of technical papers does not meet requirements as it ordinarily results in withholding information from operating personnel and it deprives the research and development engineer from the critical comments necessary for effi-

cient development. Such a policy can only result in duplication of effort and inferior standards of production. It is believed so far as welding is concerned that the harm from depriving our industries from available information far outweighs any national harm from giving information to the enemy. It is believed that a broad consideration of the problem will result in a policy that will place few technical papers on welding under the ban of the censor.

Our Annual Meeting program has been arranged on the basis of public service. Although some papers have been withdrawn because of censorship, it contains many important and timely contributions to technical literature. Participation in such a meeting can only result in economy of time and effort and an inspiration which will accelerate progress in welding.

The rate of progress in the development of welding technique and of the fundamentals of welding is high. The amounts spent on research in welding by government agencies and by industry are considerably larger than ever before. The conversion of industry to the production of war matériel has brought new problems, a wider use of high-strength materials and a vast expansion of the use of welding. The development of war emergency steels has forced a study of weldability and a rationalizing of concepts of the relation of composition, hardenability and weldability. The remarkable growth of the production and use of aluminum and magnesium alloys has created a demand for new welding methods and the development of controls to maintain uniform quality and higher production rates. Equipment manufacturers are improving their existing production and are making rapid strides in the development of new equipment. Never before has the rate of progress in developing the art and science of welding been so great.

The demands for welding engineers have exceeded the supply. Short-time engineering training courses have been organized all over the country to help meet the demand for welding engineering personnel. Lecture courses have assisted in informing operating welding engineers of current progress in their profession. The demands for training of welding operators have been more readily met. Industry now faces the necessity for the training and use of women as operators.

Because of this accelerated development and enormous expansion of welding, the AMERICAN WELDING SOCIETY is given an unusual opportunity of national service. There is a greater need than ever for its research and technical committee activities for the organization of training and educational courses and for the publication and dissemination of information. Long range views must be taken if these problems are satisfactorily solved. There is no reason to consider this war as a short war. The constant shifts and changes incidental to war can best be met if our thinking involves fundamental concepts and is based on a more complete understanding of the materials and processes we employ.

The most difficult personnel to find and train is development and research personnel. This country has during past decades neglected the development of war matériel and fell behind European nations. It is necessary not only to catch up with the Axis developments but to better them. Few realize the engineering and scientific effort involved in this world competition. The personnel capable of carrying on this development work is too precious to be dissipated to other uses even in the field forces.

The AMERICAN WELDING SOCIETY recognizes the problems that confront the War Industry in the development and application of welding. Its Sections and Headquarters organization must and will take the initiative to fulfill these obligations.

STRUCTURE AND PROPERTIES OF ALLOYS

Structure and Properties of Alloys—The Application of Phase Diagrams to the Interpretation and Control of Industrial Alloy Structures, by R. M. Brick, Instructor in Metallurgy, Yale University, and Arthur Phillips, Professor of Metallurgy, Yale University. Price $2.50. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y.

This text seeks to establish the correlation among alloy phase diagrams, microstructures and properties. Especial attention has been directed to the effect of industrial practices in casting, working and heat treating alloys on the application of, or departure from, theoretical principles. One hundred thirty-six photomicrographs, with full descriptions of their origins, illustrate normal and abnormal structures of most standard alloys.

TEMPILAQ°—TEMPERATURE-SIGNALING MEDIUM, NOW IN LIQUID FORM

Tempilaq°, a new and ingenious addition to the line of Tempil° thermometric products, was introduced to industry by the Tempil Corp. in their exhibit at the National Metals Show. Employing the same principle as the widely used Tempil° Pellets and Tempilstiks°, the new product is available in a wide range of Pre-determined melting points between 125° and 1600° F.

Tempilaq° procedure is simplicity in itself. A thin smear or daub is applied to the working surface and dries in an instant. When the temperature stated on the Tempilaq° bottle is reached, the smear liquefies sharply. On cooling, it solidifies, leaving a glossy or vitreous mark distinctively different from the original smear.

G-E SALVAGE SUPERVISOR DESCRIBES COMPANY'S SALVAGE OPERATIONS BEFORE METAL CONGRESS

The General Electric Company is recovering scrap metals at a rate of one million pounds per day, Harry J. Beattie, supervisor of the company's salvage department, told the National Metal Congress.

"An average of 14 carloads of salvaged metal are shipped to mills, foundries and smelters every day in the year," Mr. Beattie told representatives of more than 300 manufacturing concerns gathered to study methods of doing more in war production with material now available. Mr. Beattie added that by weight approximately 90% of the metals recovered by General Electric is steel and iron.

"Approximately 20% of our salvaged materials are re-used as raw materials in our operations," he said. "Steel scrap is specially prepared for charging in our electric furnaces for making steel castings. Cast-iron scrap is broken into suitable size for cupola charging to make cast-iron castings. Copper scrap is wound into small bundles for crucible use in our alloy foundries. Several of our salvage departments have furnaces for reclaiming lead, babbitt and solders."

Mr. Beattie pointed out that General Electric maintains within the company and separate from the salvage department, an organization which is constantly developing new ways of reducing the amount of materials necessary in manufacture. Paralleling the efforts of designing engineers, draftsmen and methods men in this organization is the company's suggestion system which rewards war workers for suggesting production improvements.

"The war has brought home to everyone the importance of salvaging materials and the government early recognized the vital need of salvaged metals by placing them at the top of the list for control," he said. "The scrap business, due to its nature, is very complicated and I think the government agencies are doing a good job in regulating it.

"The regulations cause us, as producers of scrap, some inconvenience, as we expend a great many man-hours making our government reports and we lose a lot of sleep keeping up with amendments to price schedules. However, the net result is that we know more about the scrap business than we did a year ago. We segregate the materials better. We turn it over faster. And it is going where it will do Uncle Sam's armament program the most good.

"There is only one issue today and that is to win the war. But the benefits gained from this war experience will last long after the war is over."

FOR INFORMATION ON MAINTENANCE AND SALVAGE METHODS

In the interest of industrial conservation, and to help speed war production, Metallizing Engineering Co., Inc. is offering a total of $650.00 in War Bonds for details of maintenance and salvage procedures with the metal spraying process. First Prize is $250.00, Second Prize $150.00, Third Prize $100.00, and three prizes of $50.00 each. Contest closes December 15th. Complete information and entry forms obtainable from Metco News, 21-07 41st Avenue, Long Island City, New York.